Status of E/p in Crack and Plug

Pedro A. Movilla Fernández (LBNL)

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Introduction

Where we are:

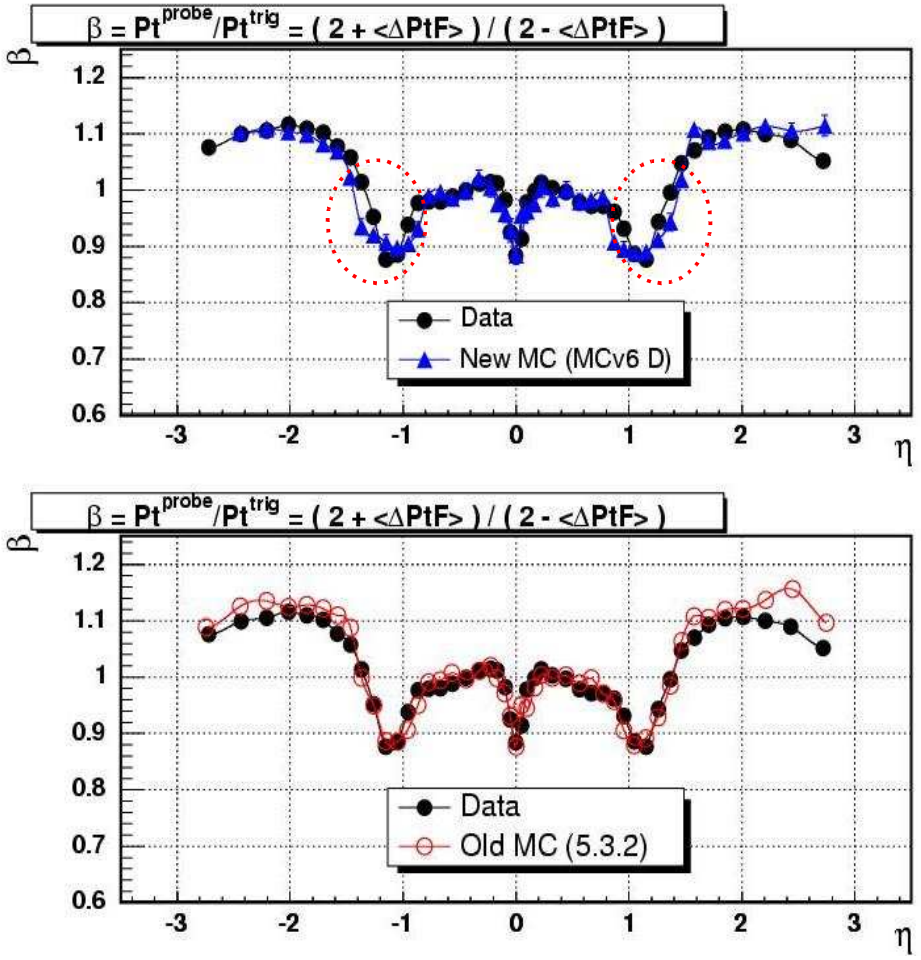
- We tuned the Gflash hadronic lateral profile to agree with the measured profiles in the Central. Tuned parameter values are currently used for all detector parts.
- Various iterations to tune FEDP and relative sampling fractions were done in the Central using the new lateral profile (see previous Shawn's talks).
- What is the impact for the E/p measurement in Crack and Plug?

This talk:

- Establish “reasonable” measurement of E/p versus p in Crack and Plug based on all available isolated single track data.
- Comparison with MC (FakeEv + MB) based on cdfSim/ProductionExe 6.1.4int1 (MCv6 B).
- E/p dependence on lateral profile and background.
- Appendix: E/p distributions.

Di-Jet Balance

- Ken showed in the last Simulation Group meeting that the MC based on the new tuning significantly underestimates the measured di-jet balance in the Crack region.
- Agreement in Plug region not bad but still improvable.
- Simulated JES in Crack/Plug is lower w.r.t. old tuning.
  More leackage of energy at the jet cone boundaries due to wider profiles at high p?



Data Sets

Single Track Trigger Data:		statistics	production
• 3, 4, 7 GeV/c thres.:	gjtc0d	~16M events	5.3.3_nt
• 10 GeV/c thres.:	gjtc0h_stt10	~4M events	6.1.2
• 15 GeV thres:	gjtc0h_stt15	~6M events	6.1.2
Minimum Bias Data:			
• gmbs0d		~21M events	5.3.3_nt

Remarks:

- STT data contain single tracks in crack/plug region as byproduct
- STT data has no visible threshold effects in crack/plug:
  Have verified that there are no charge asymmetries (as e.g. observed in the gjtc0h_stt15 sample in the central)

Track Selection

Event quality:

- Number of vertices: 1
- |Z(vertex)| < 60cm

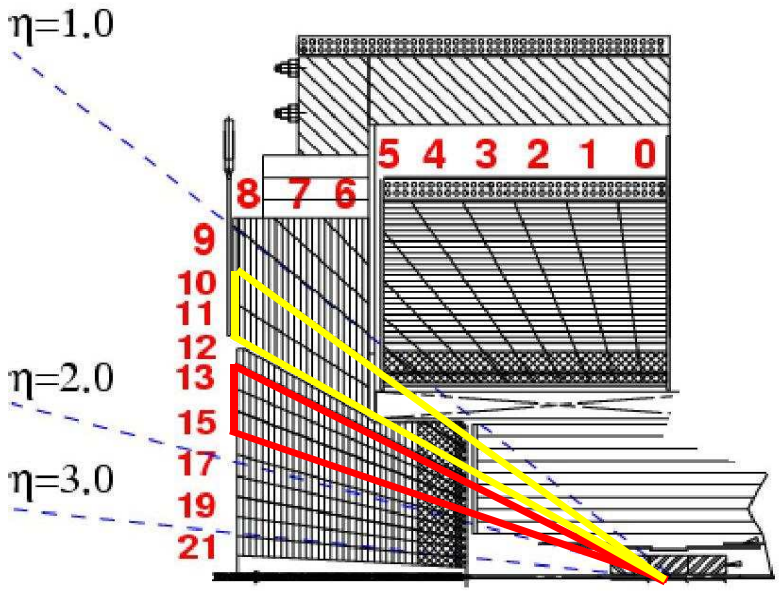
Signal region:

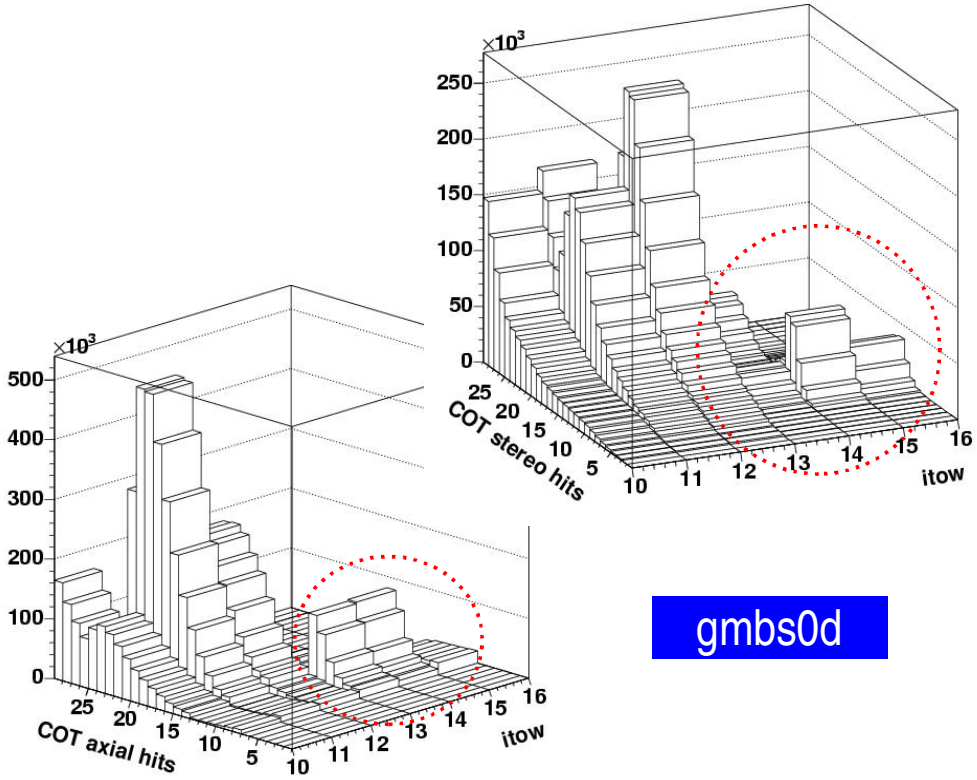
- 7x7 isolation
- Track extrapolates to PES of signal regions:
  "Crack" = Tower 10 and 11
  "Plug" = Tower 13, 14, 15
- Partial CES isolation for crack towers

Track quality:

	COT hits		Silicon hits		
	axial	stereo	axial	stereo	z
Crack:	≥20	≥20	≥4	-	-
Plug:	≥7	≥7	≥4	≥2	≥2

Using IO tracks is crucial for reasonable E/p measurement in the plug!
(see e.g. my SGM talk of July 20, 2005)

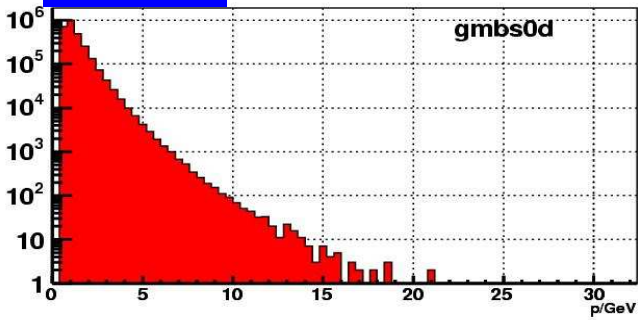


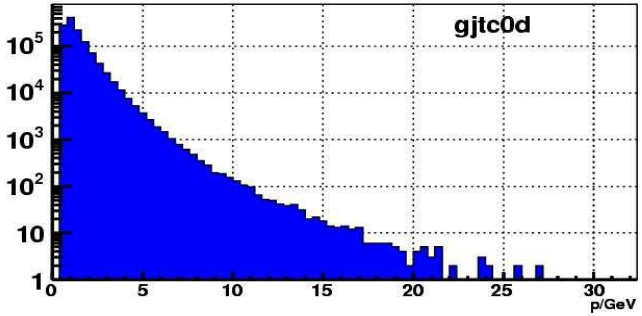


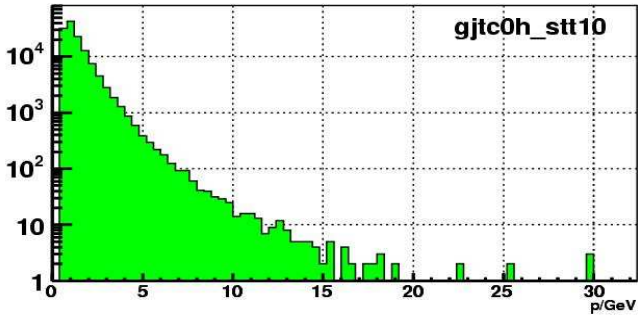
gmbs0d

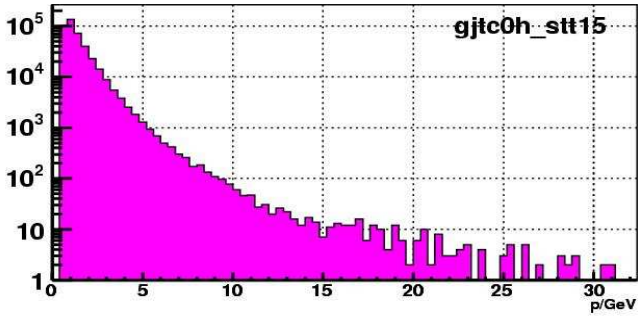
Isolated Track Statistics

Crack

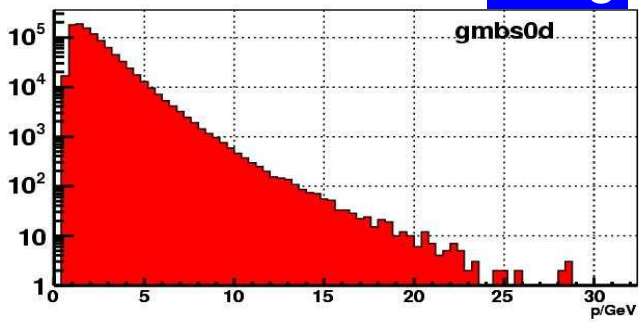


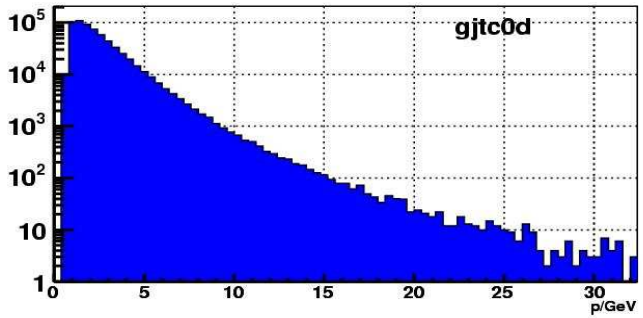


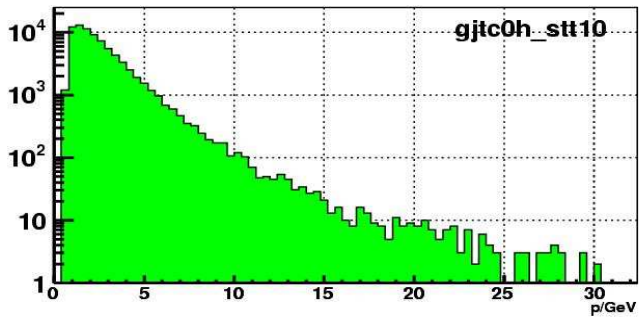


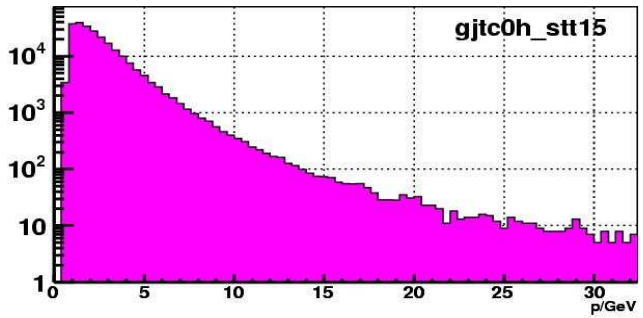


Plug









Signal Definition

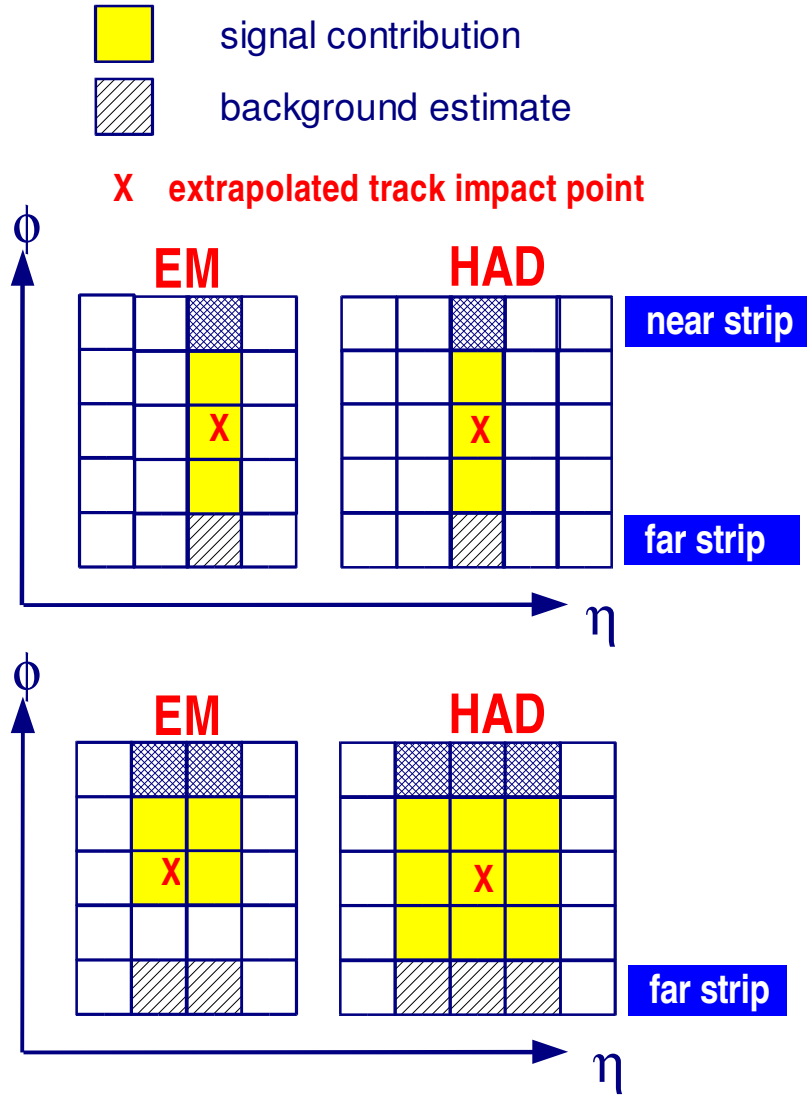
- Tracks are extrapolated to PES for both EM and HAD compartment
- Plug: adjacent towers in ϕ are paired

Crack	EM	HAD
Signal:	3x1 strip	3x1 strip
Backg:	1.5 x (near + far block)	

Contour cut: $|\eta^{rel}| < 0.6$, $|\phi^{rel}| < 0.9$

Plug	EM	HAD
Signal:	2x2 blocks	3x3 blocks
Backg:	2x far strip (1x2)	3xfar strip (1x3)

Contour cut: $|\eta^{rel}| < 0.9$, $|\phi^{rel}| < 0.9$

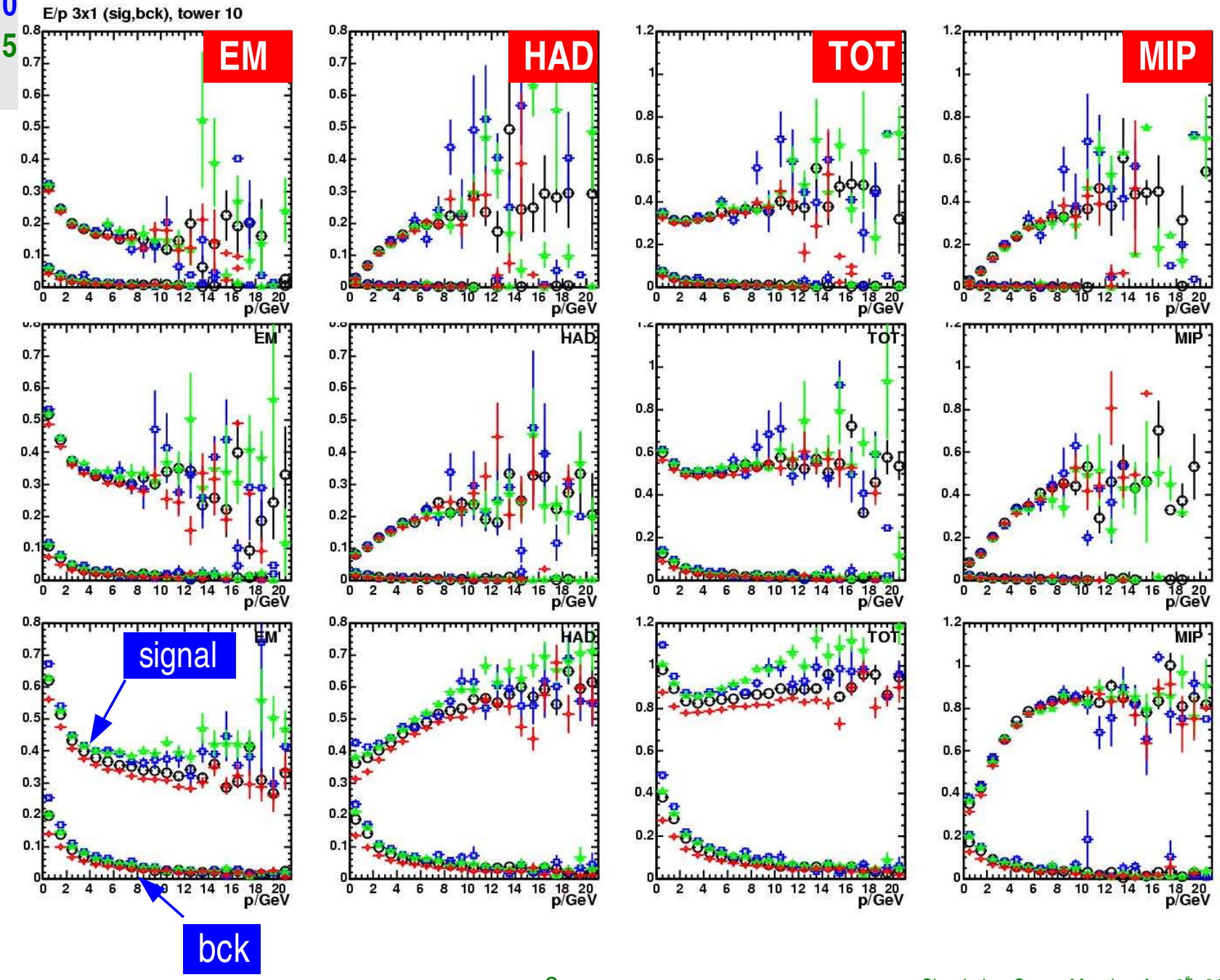


Plots shown in the following:

EM, HAD, TOT=EM+HAD, MIP=HAD (EM<670MeV)

Signal and Background (Data Only, Simple Means)

gjtc0d
gjtc0h_stt10
gjtc0h_stt15
gmbs0d

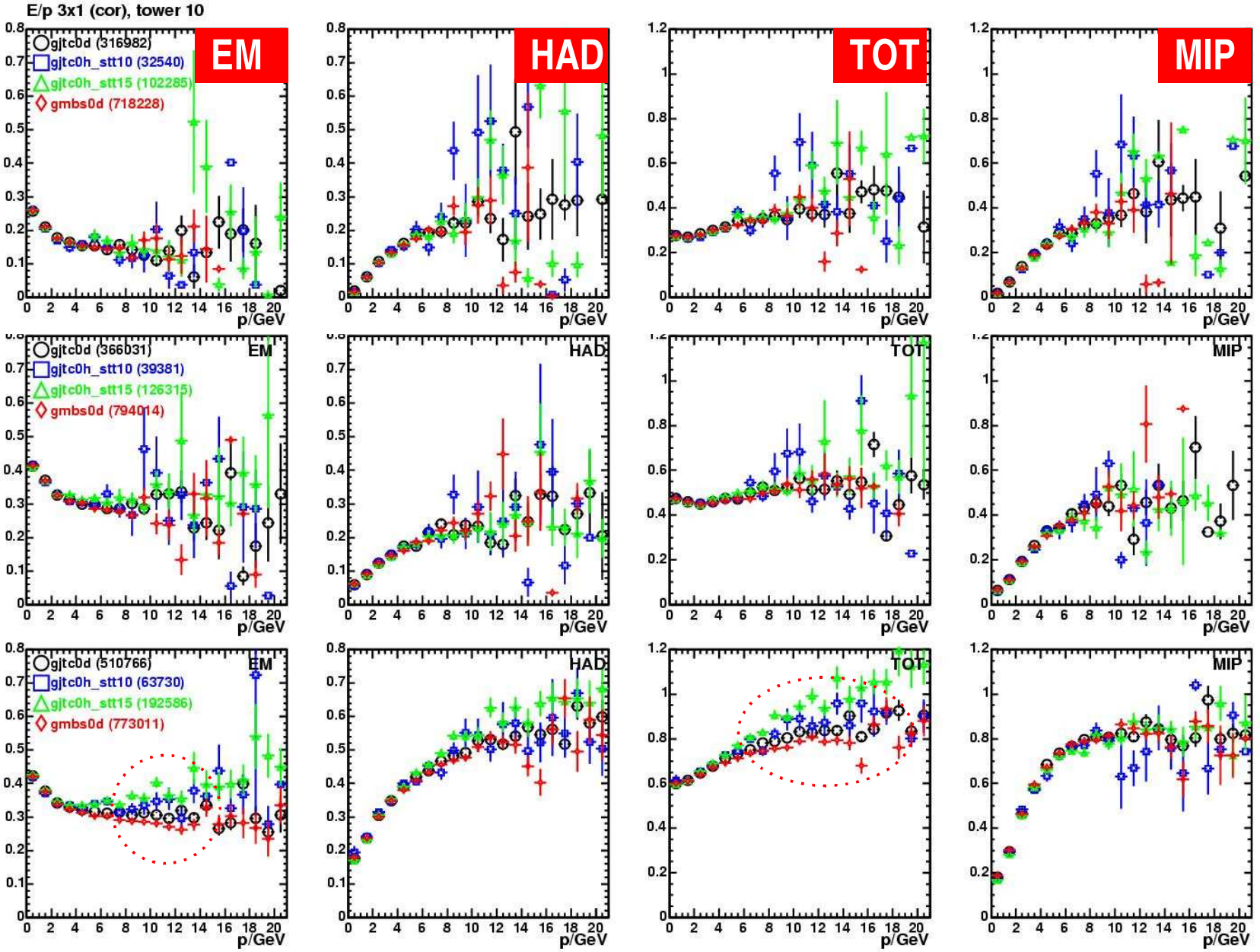


Corrected Signal (Data Only, Simple Means)

tower 10

tower 11

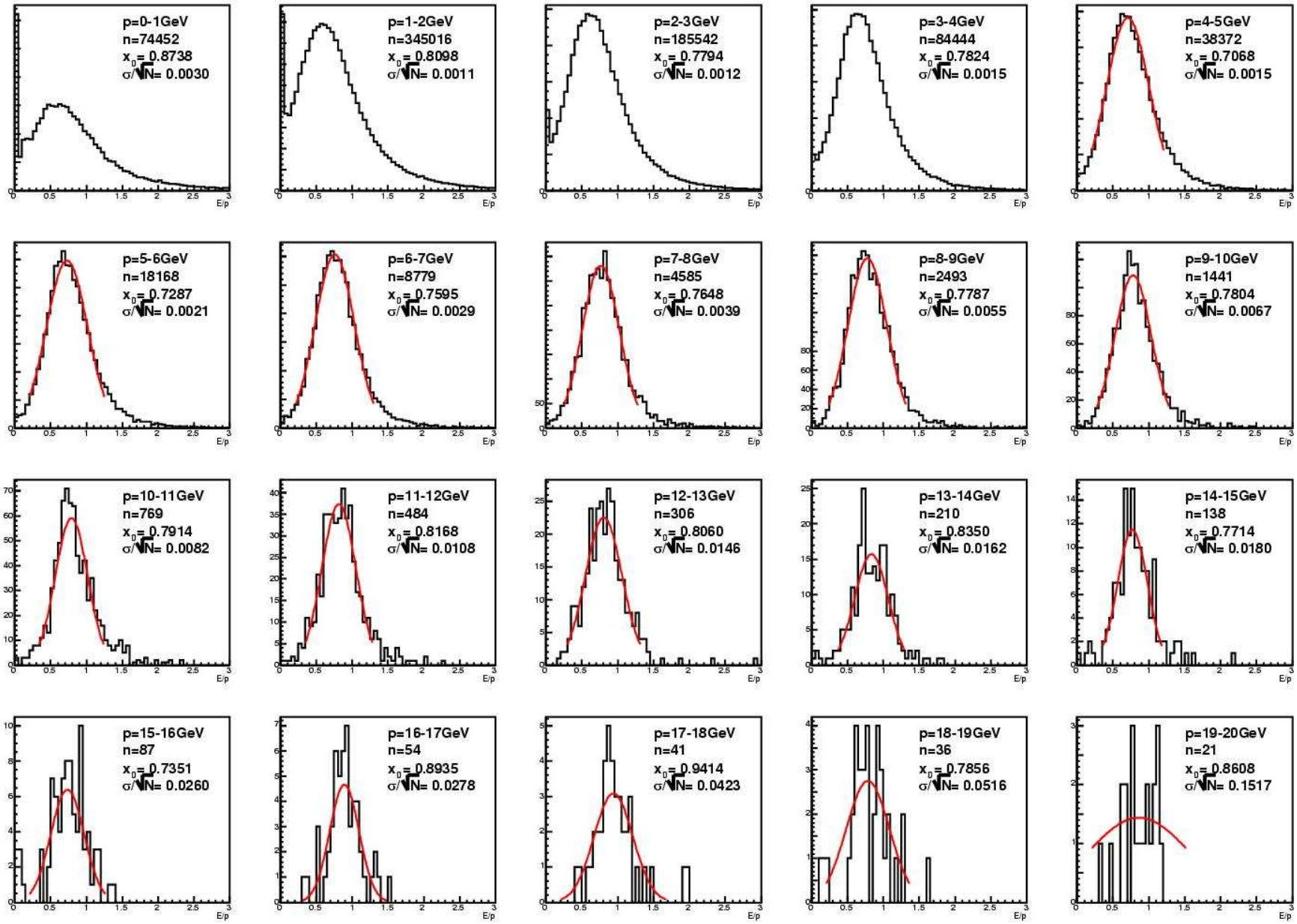
plug



Using Gaussian Means in the Plug

- Different data sets generally provide a consistent measurement of the single particle response.
- Exception: EM response in the plug at p>5GeV/c.
  gjtc0h_stt15 > gjtc0h_stt10 > gjtc0d > gmbs0d
  Different contributions due to correlated backgounds?
- For TOT, uncertainties due to background problems can be absorbed using Gaussian means instead of simple means.
- Apply “converging Gaussian fits” to TOT and MIP distributions in the plug for p>4GeV/c to extract mean and sigma.
- For tower 10, Gaussian fits are not feasible. To be consistent, employ simple means for both crack towers

Gaussian Fit Example (gmbs0d, Plug)

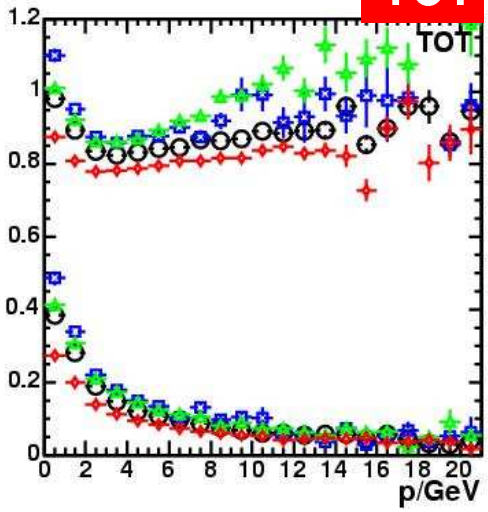


Using Gaussian Means for the Plug

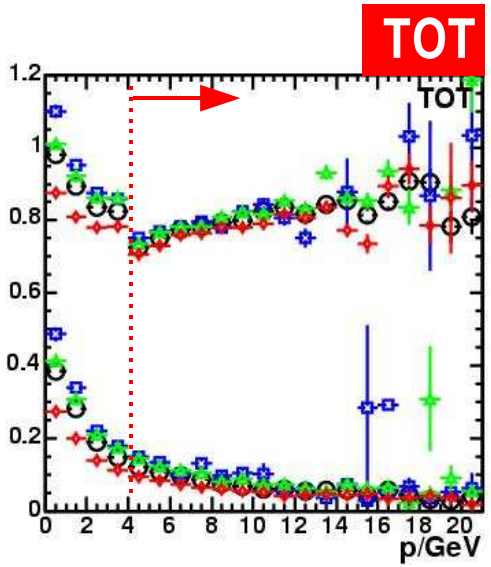
Simple means

Gaussian means

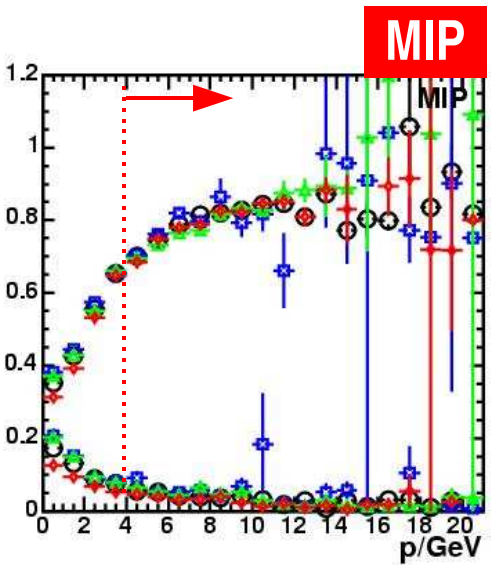
TOT



TOT



MIP



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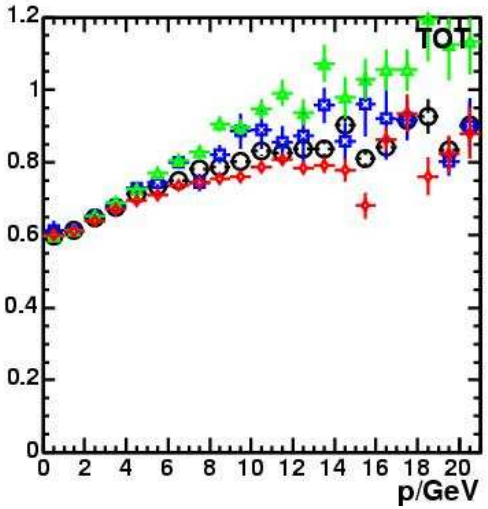
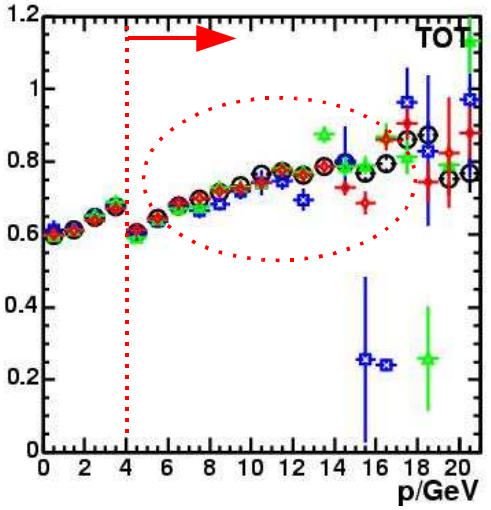
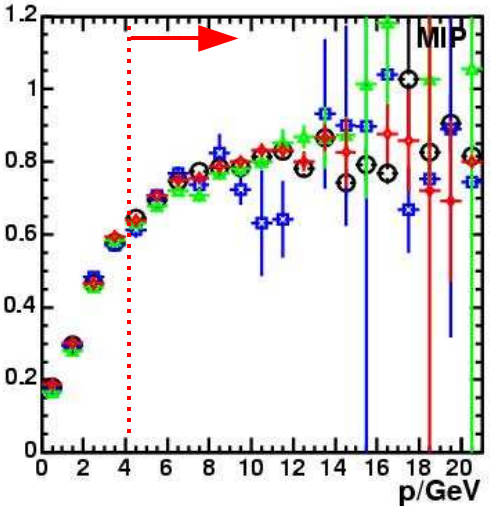
corrected







MC Samples

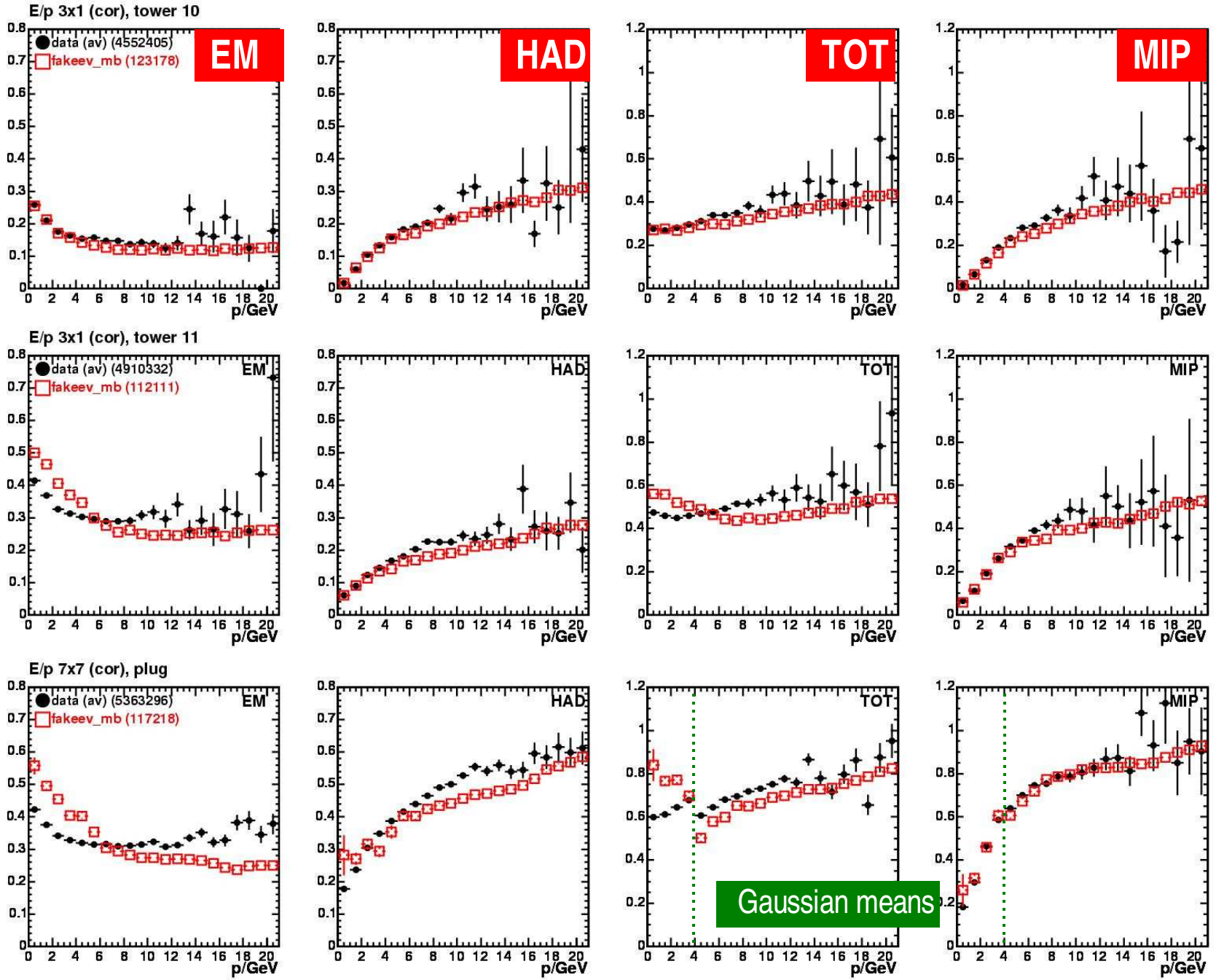
MC samples were generated isolated tracks using FAKE_EV:

- 3 tracks per event
- flat spectrum, $|\eta| = 0.72 - 2.1$ (covering towers 6 to 17)
- pions/kaons/protons ~ 6/3/1
- processed with cdfSim / ProductionExe 6.1.4int1 (MCv6 B)

Pythia Minimum Bias Tune A superimposed on top of each event

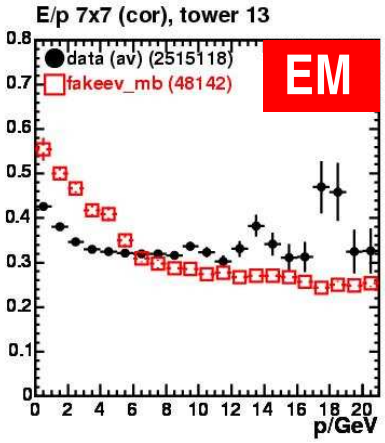
For the comparison data/MC, the data points from the four individual data samples gjtc0d, gjtc0h_stt15, gjtc0h_stt10 and gmbs0d, were first corrected for background and then combined using the weighted average.

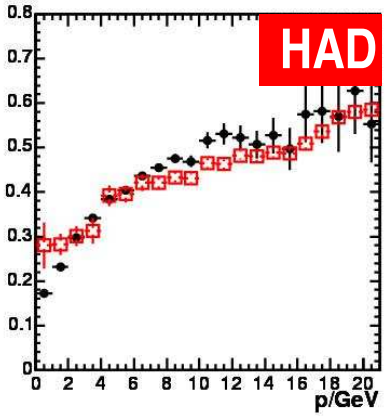
Fakeev Minbias vs Data Average

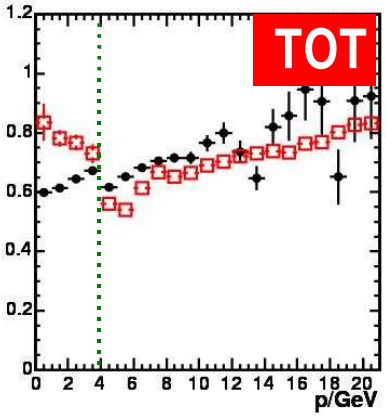


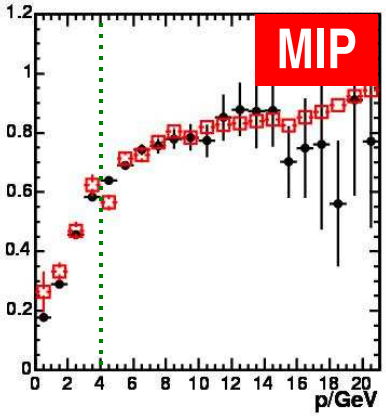
Fakeev Minbias vs Data Average (Plug Towers)

tower 13

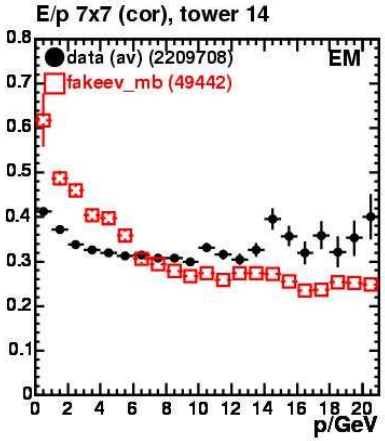


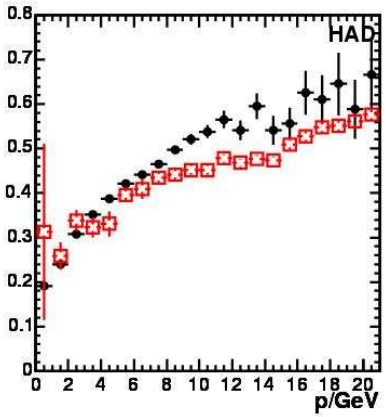


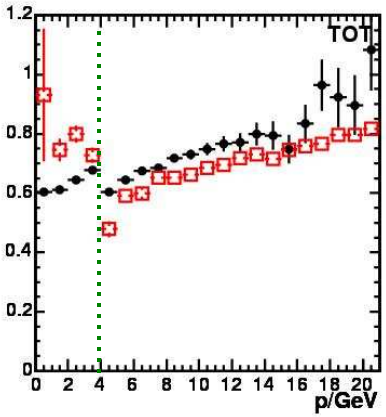


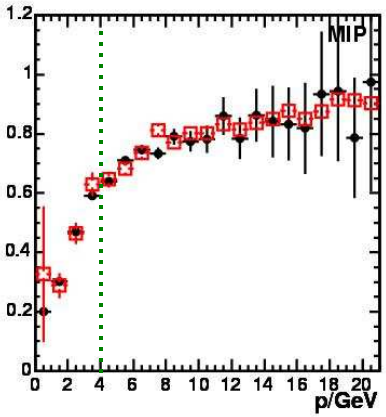


tower 14

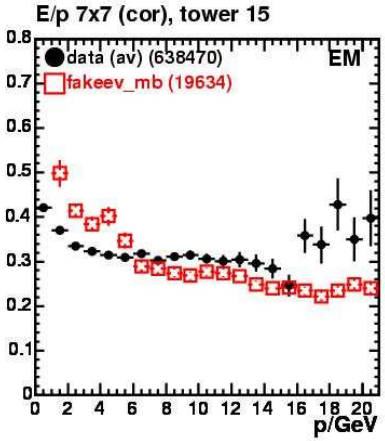


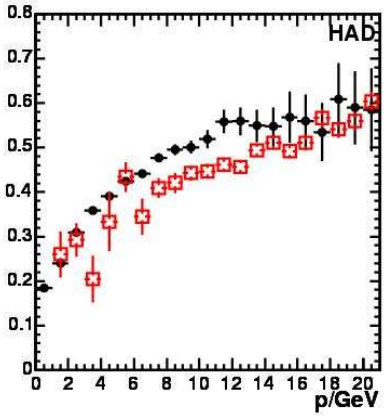


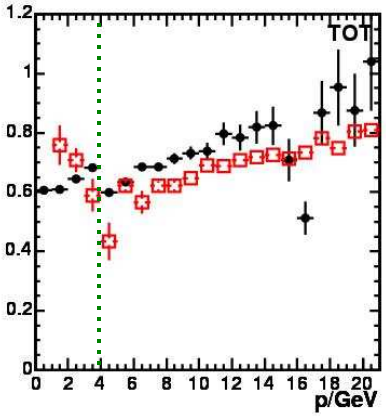


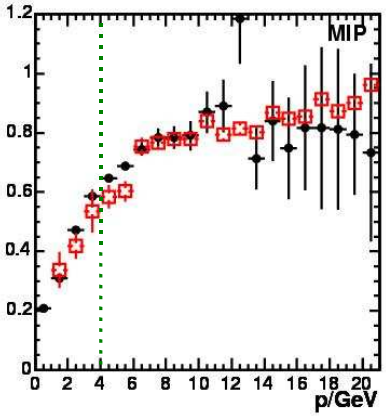


tower 15









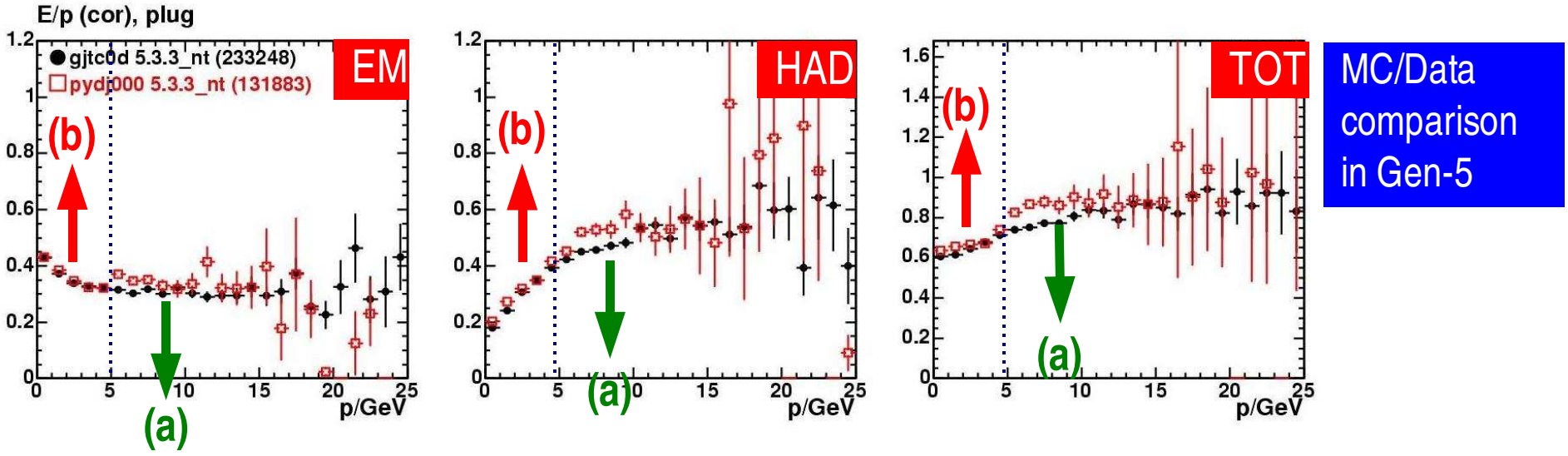
Findings

- In tower 11 and Plug, the MC significantly exceeds the EM and TOT response for p<6GeV/c and underestimates EM and TOT for p>6GeV/c
- Simulated HAD reponse in fair agreement with data (tower 10+11) at p<4GeV/c but generally systematically lower at higher p
- Simulated MIP response ok in Plug, a little too low in Crack.

Possible explanation: Leackage effects due to limited signal region.

(a) Widening the lateral profile at p>5GeV/c increases leackage

(b) Narrowing the lateral profile at p<5GeV/c decreases leackage



Effect also present in the central (few %) but is larger in the plug (finer granularity)

Dependence on the Lateral Profile

- So one problem of tuning the simulated absolute single particle response in the Plug is the current signal definition (EM 2x2 blocks, HAD 3x3 blocks)
- The past tune at p<5 GeV (shown in last slide) looks optically nice but relies on the assumption of (probably wrong) lateral profile parameters:
  - derived using limited isolated tracks statistics
  - mainly based on SISA tracks faking too low E/p due to resolution effects
  (see my SGM talk July 20th 2005)
- Widening the signal region would probably increase mismeasurements due to background contribution. Furthermore, only 4 towers in Plug can be "hit" by IO tracks.

We need to make the simulated lateral profile in the Plug as perfect as possible before adressing the issue of tuning of the absolute response. Central tuning results are still not optimal for the Plug (too narrow profiles at low p.)

Effect of Varying the Lateral Profile

- The following plots show the effect of varying the Gflash lateral profile core parameter R_1 from 0.05 to 0.50 as a function of the tower (towers 6 - 15)
- Old R_1 values used in Gen-5:

  p<5GeV/c: 0.490

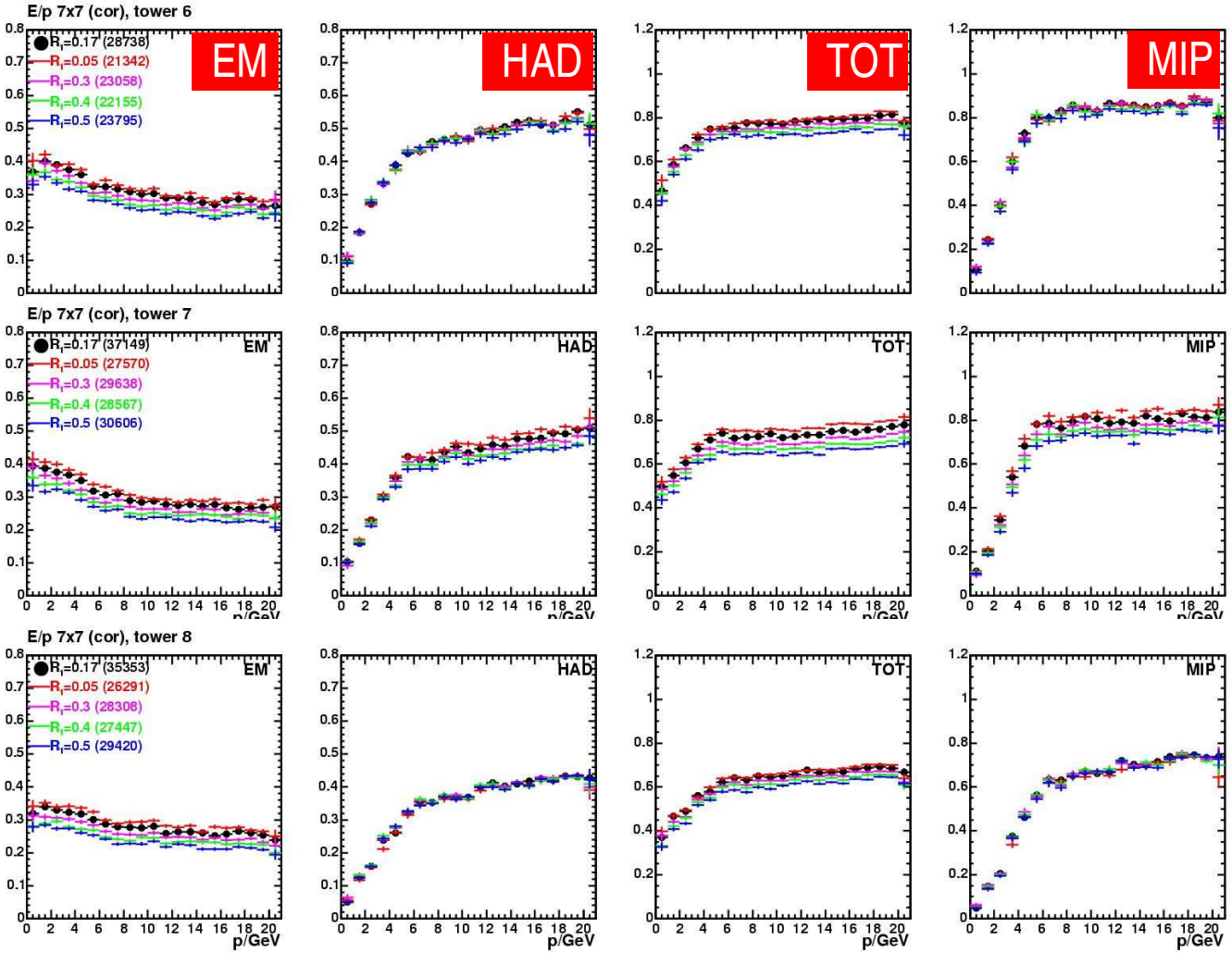
  p>5GeV/c: 0.015
- For this study, only FakeEv Pions w/o Pythia MB were generated.
- Have also looked how the impact of the underlying event on E/p changes from tower to tower.

Dependence on Lateral Profile (Wall)

tower 6

tower 7

tower 8



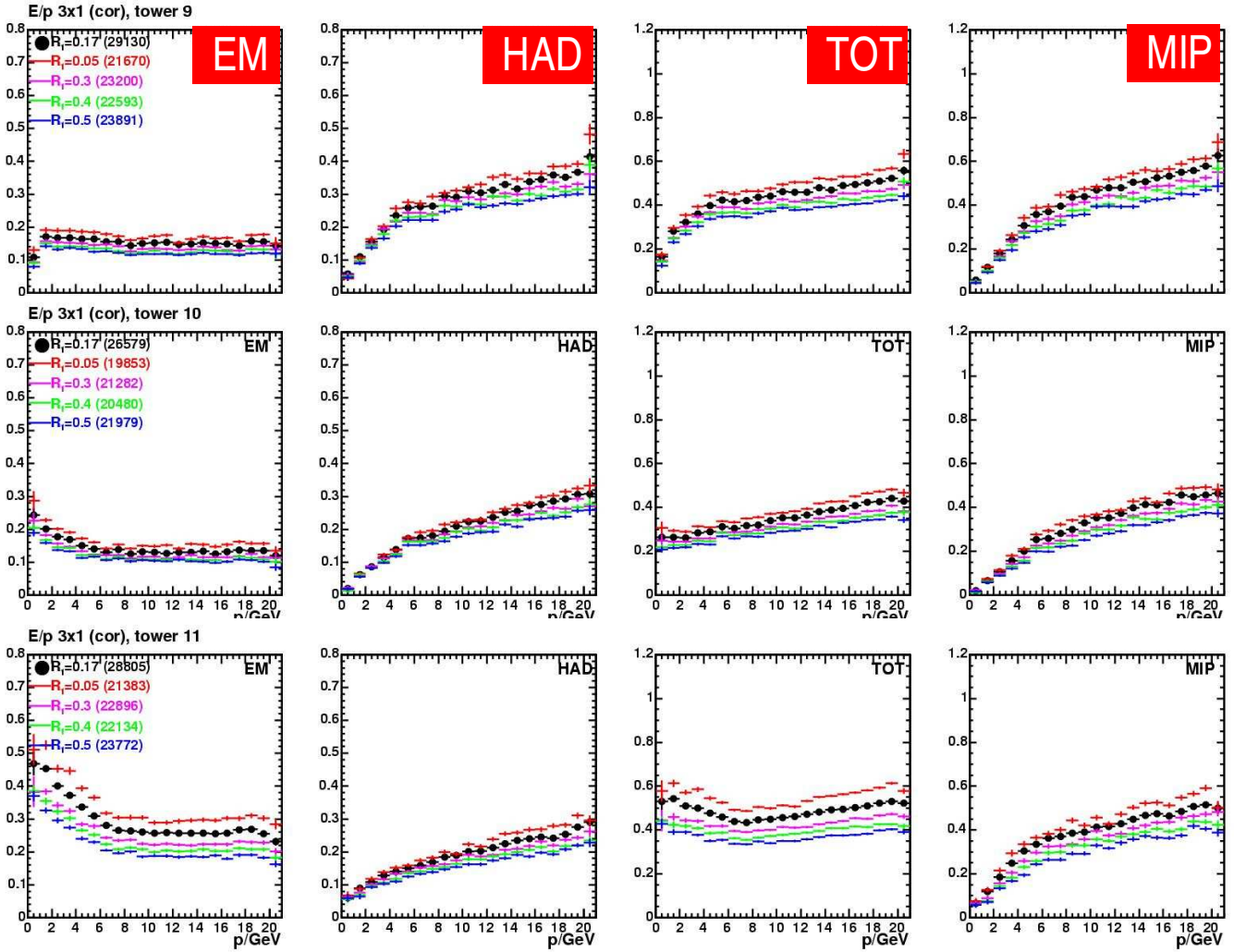
Dependence on Lateral Profile (Crack)

tower 9

tower 10

tower 11

!!!



Drastically increased effect starting with tower 11.

(No effect in EM of tower 10 because of poor instrumentation + more passive material?)

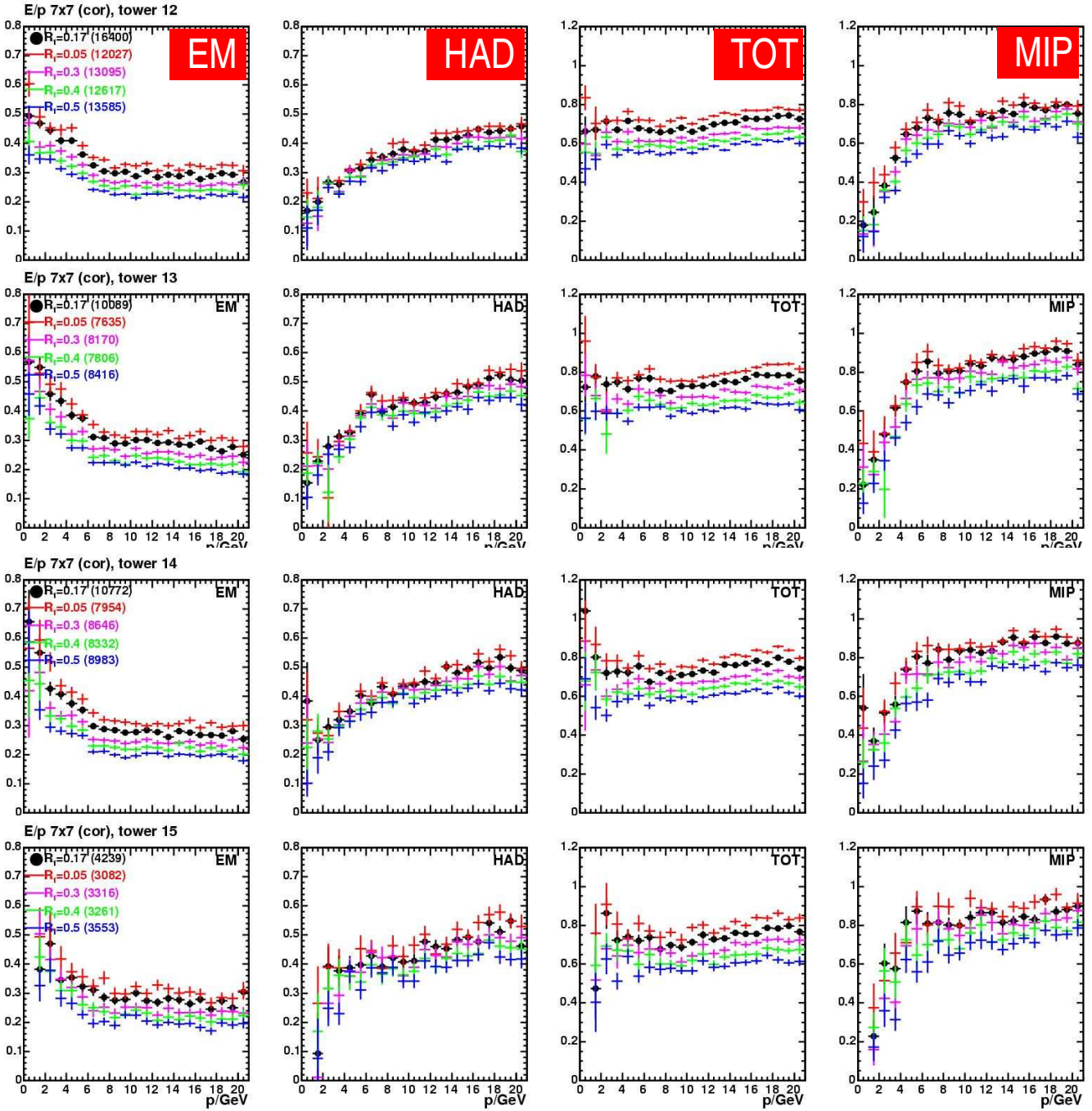
Dependence on Lateral Profile (Plug)

tower 12

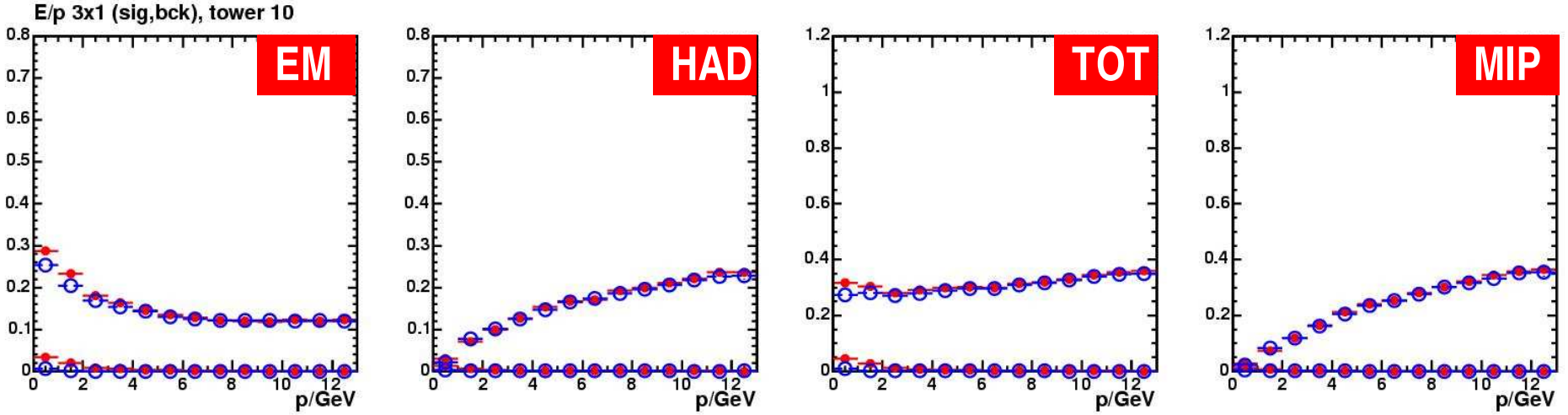
tower 13

tower 14

tower 15



Impact of MinBias (Tower 10)



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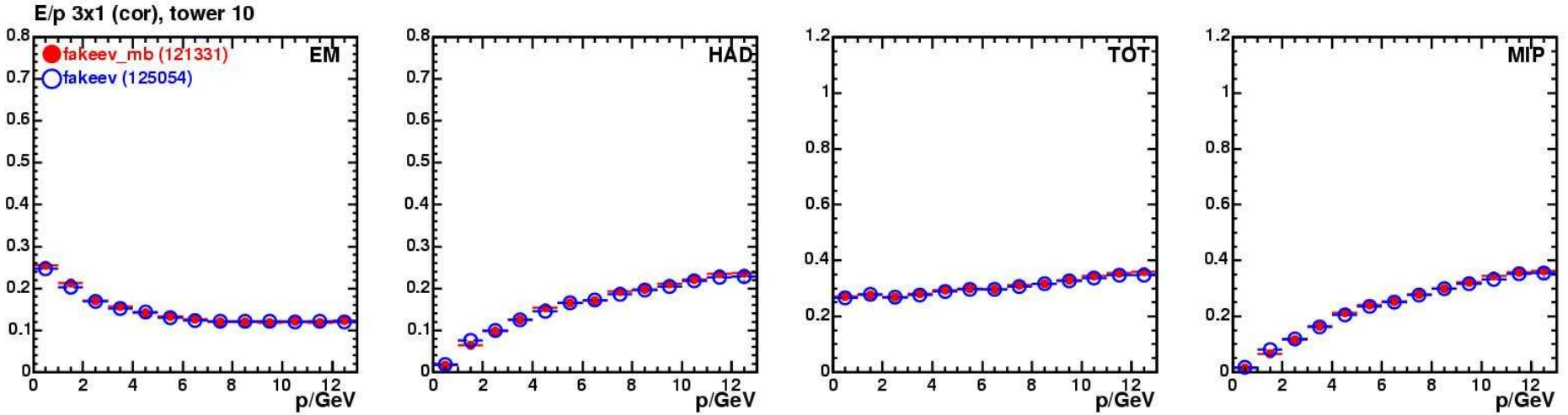
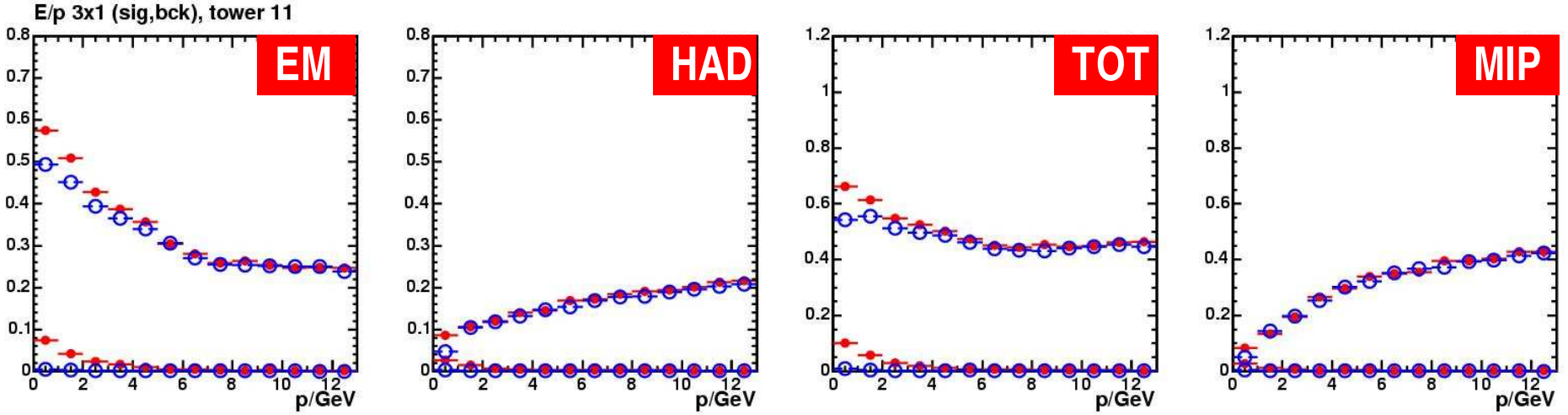


Impact of MinBias (Tower 11)



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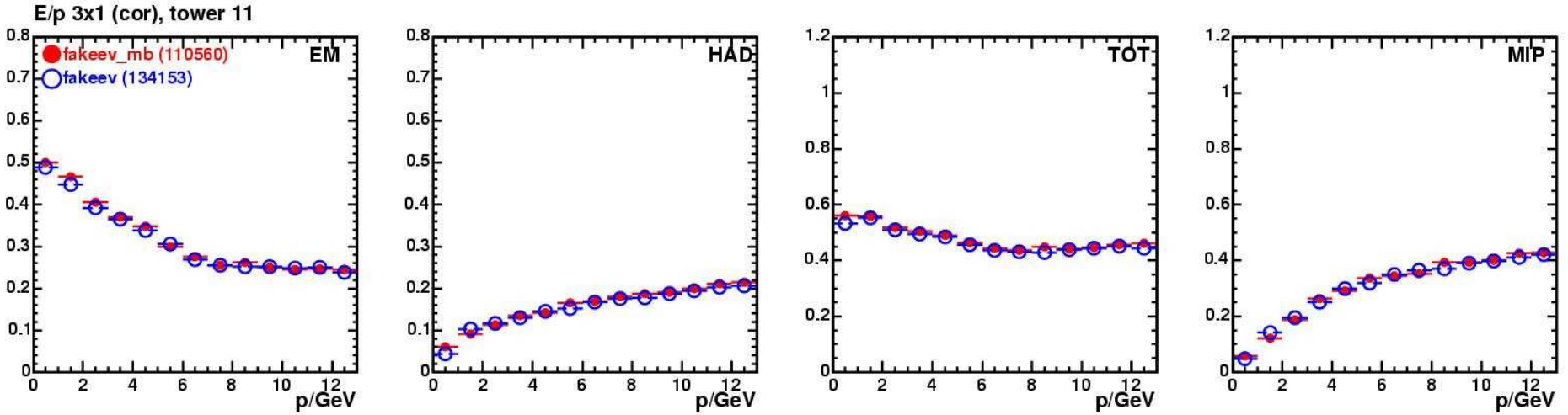
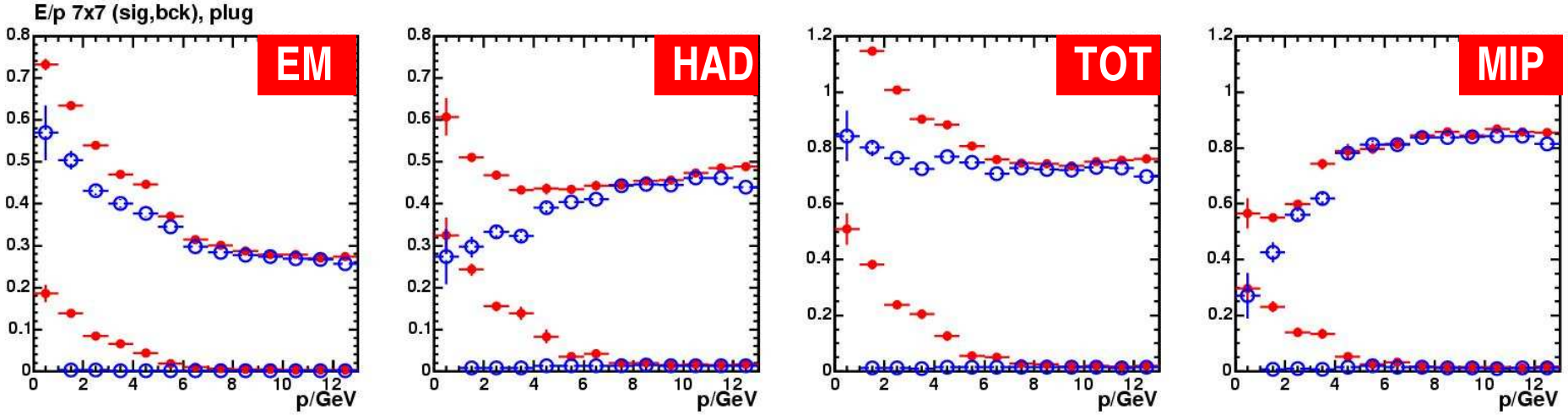


Impact of MinBias (Plug)



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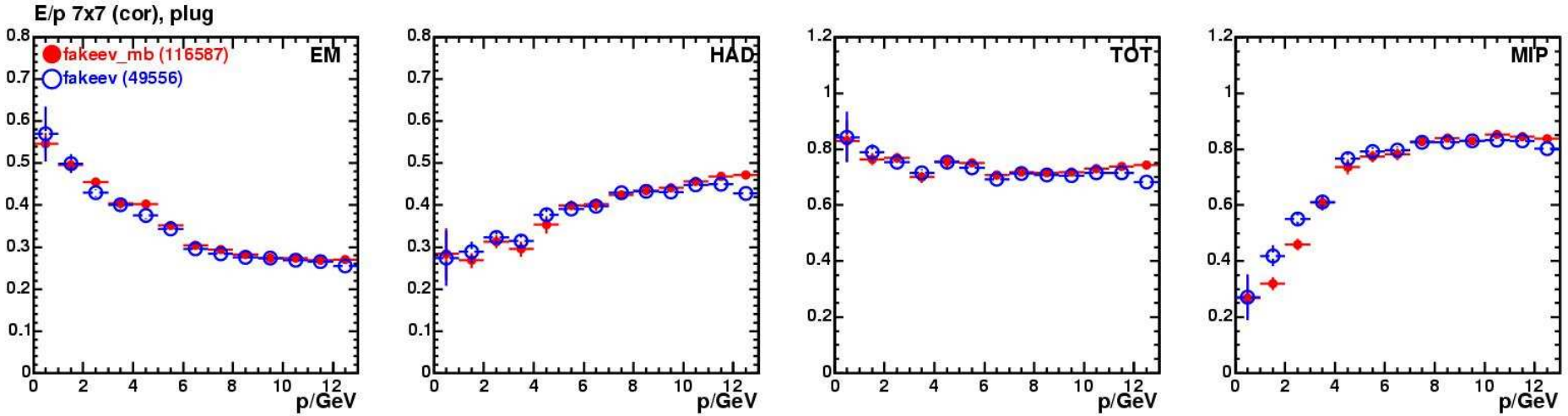
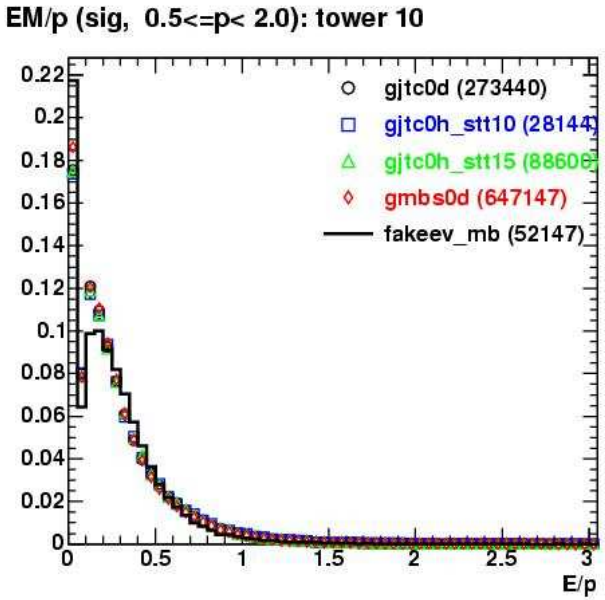


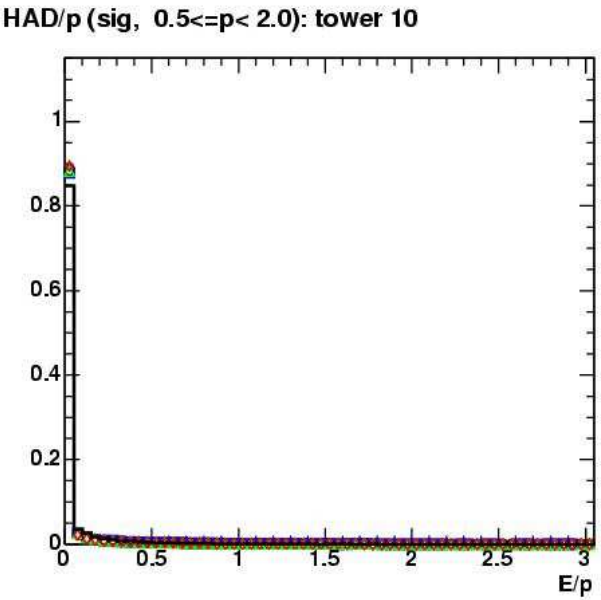
Conclusions

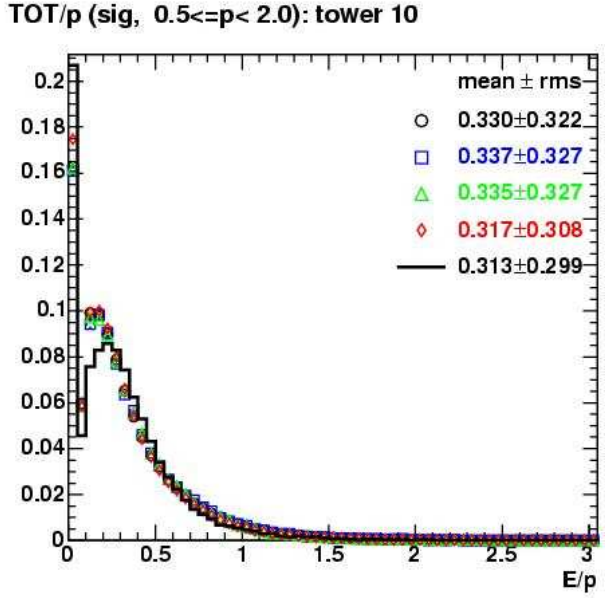
- Consistent measurement of single particle response in Crack and Plug using different data sets.
- Interdependence of lateral profile and absolute E/p response in the Plug caused by non-negligible shower leackage effects due to limited signal region.
- Careful tuning of the lateral profile before tuning the absolute response necessary.
- Currently used lateral parameters derived from the Central (see previous talk) still not perfect.
- Based on the currently used lateral profiles, the simulated energy scale in Crack and Plug has to be decreased at low p and increased at high p.

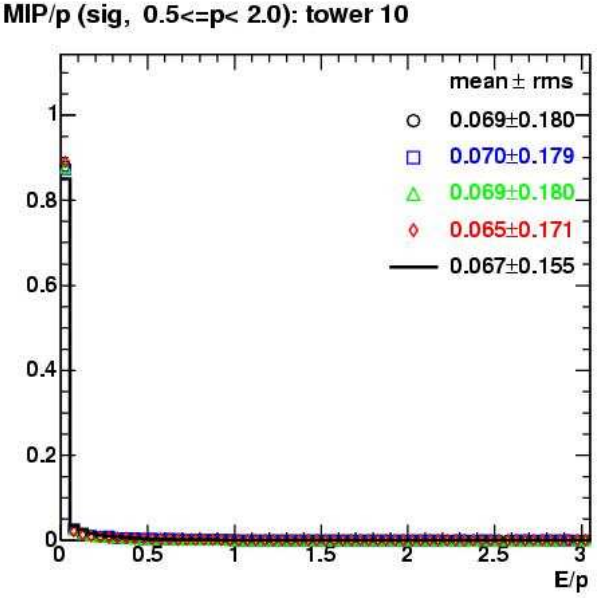
Appendix: Normalized E/p Distributions

Tower 10 (0.5-2 GeV/c)

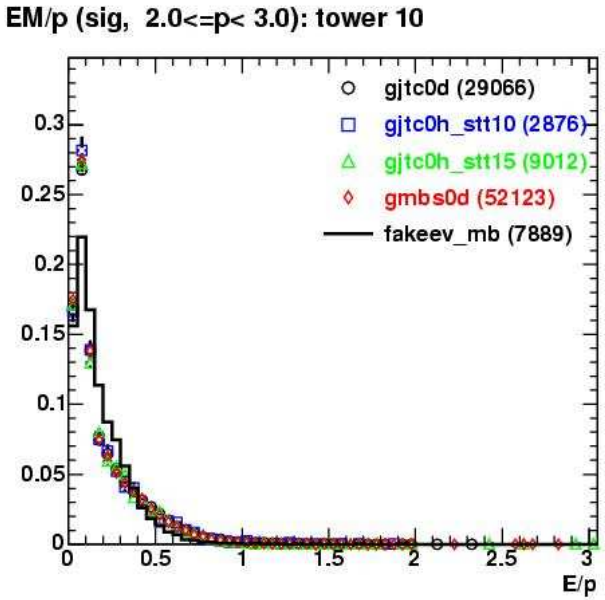


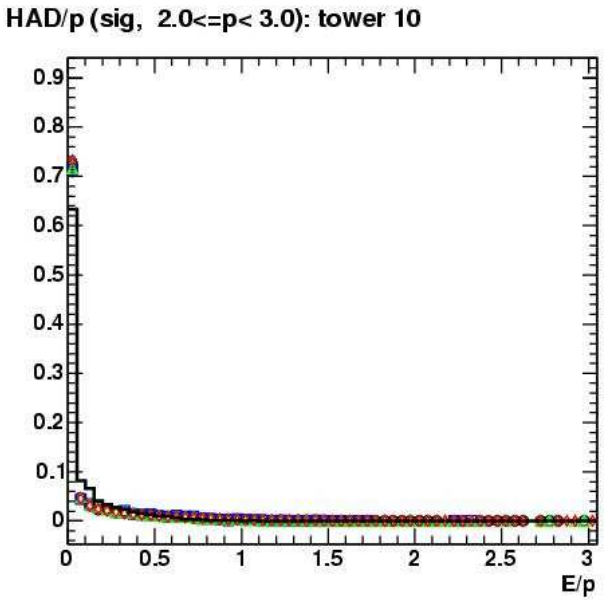


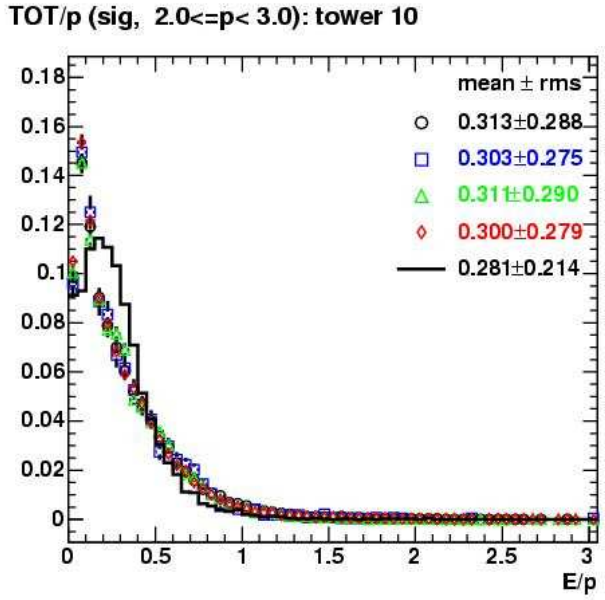


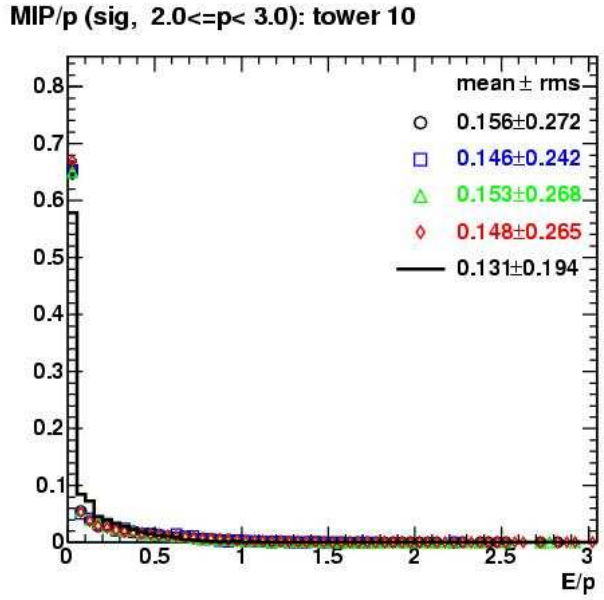


Tower 10 (2-3 GeV/c)

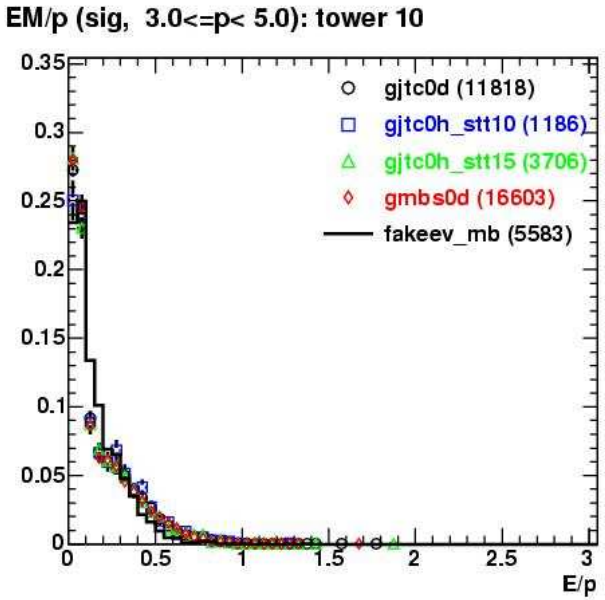


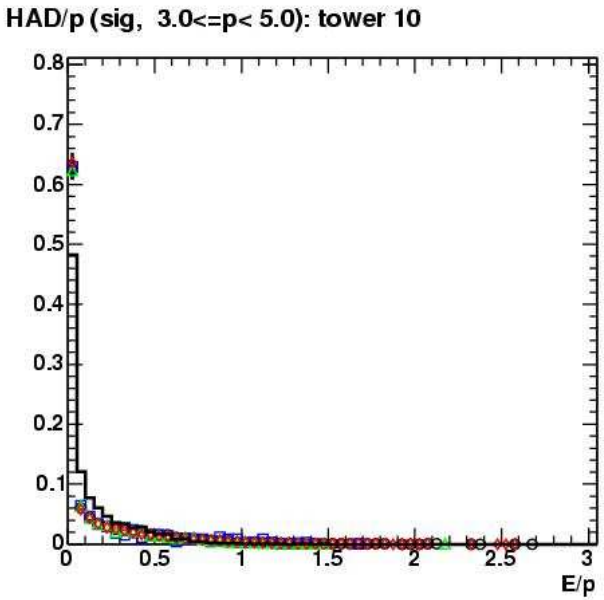


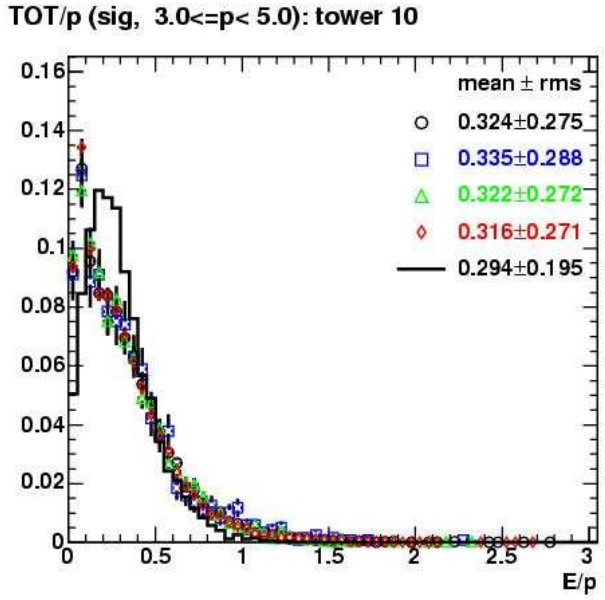


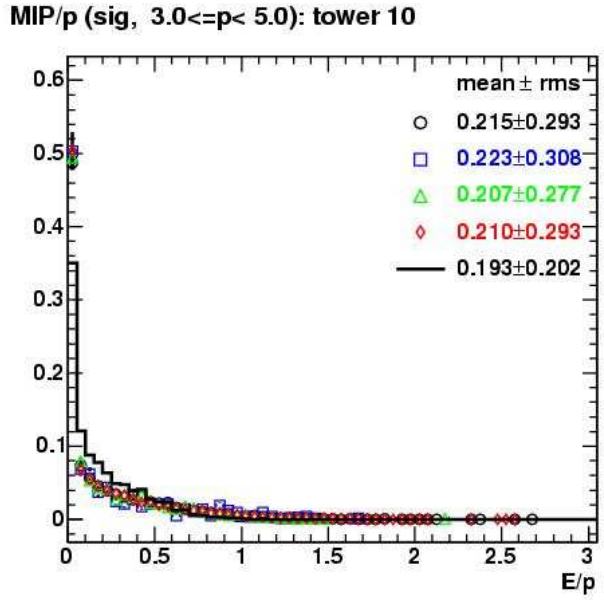


Tower 10 (3-5 GeV/c)

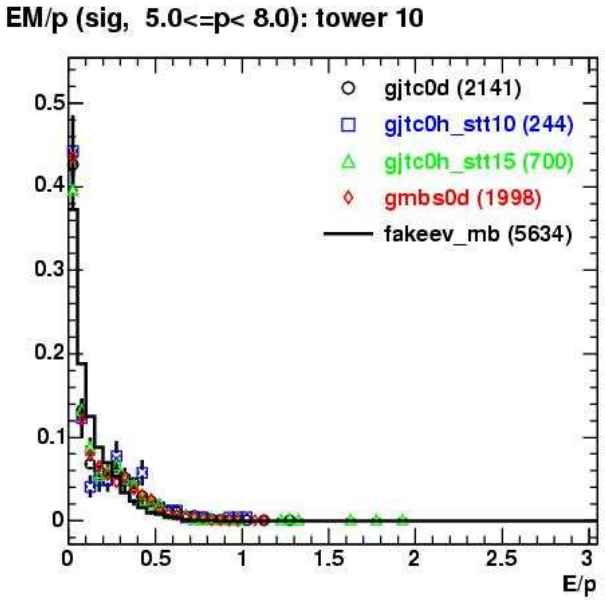


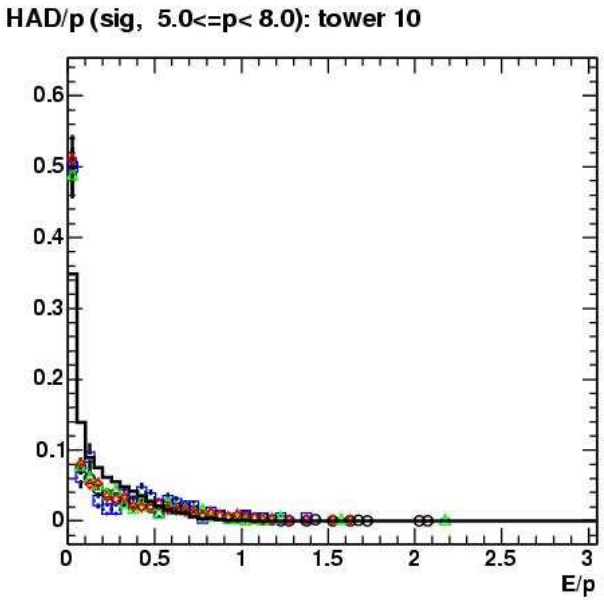


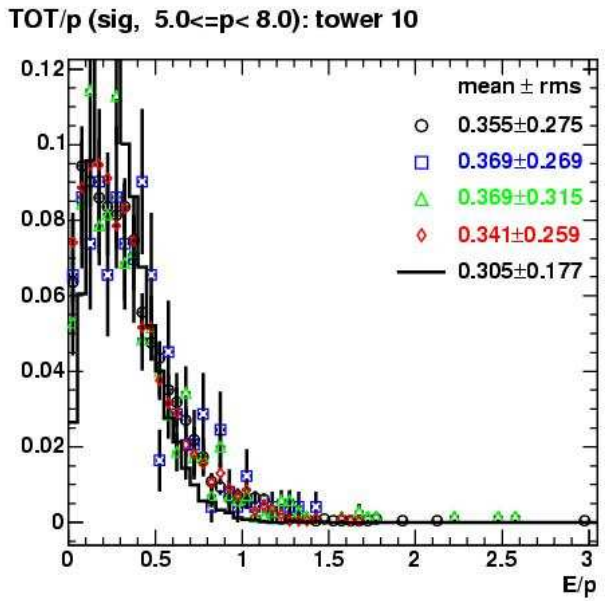


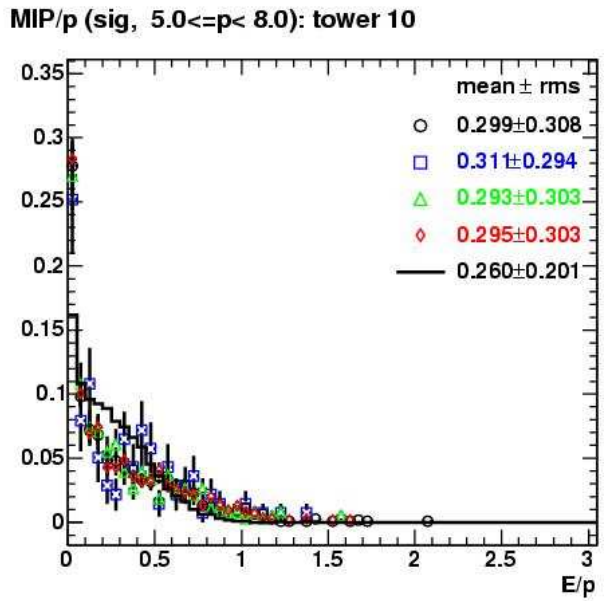


Tower 10 (5-8 GeV/c)

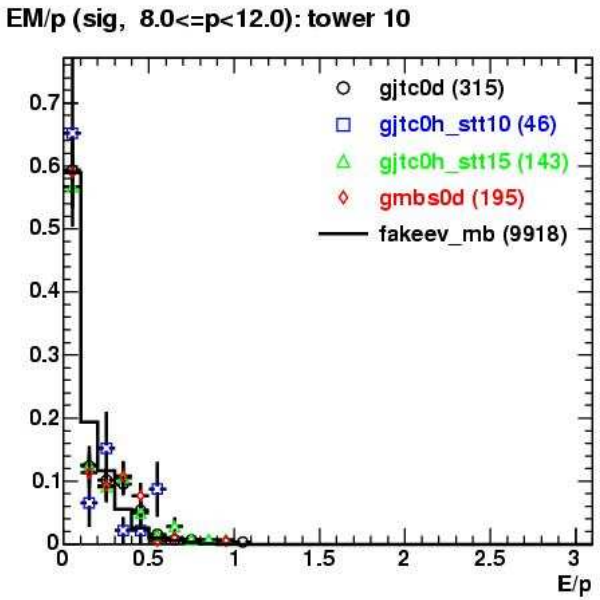


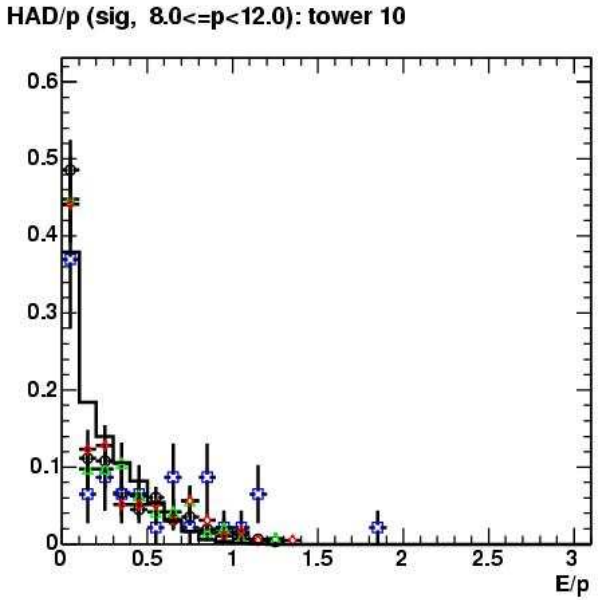


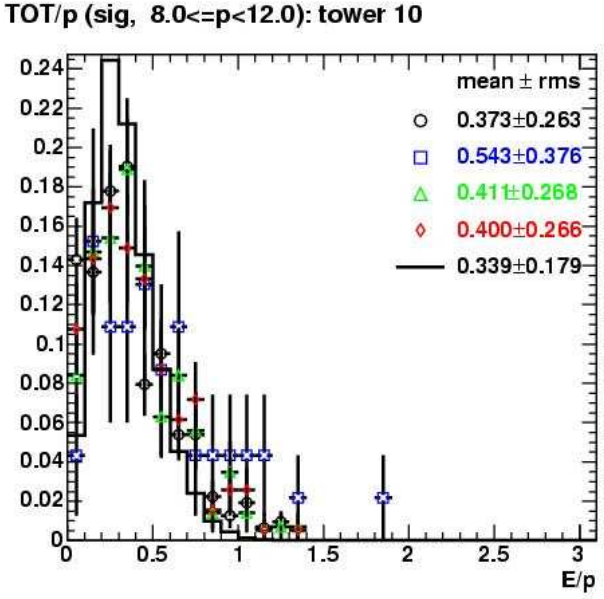


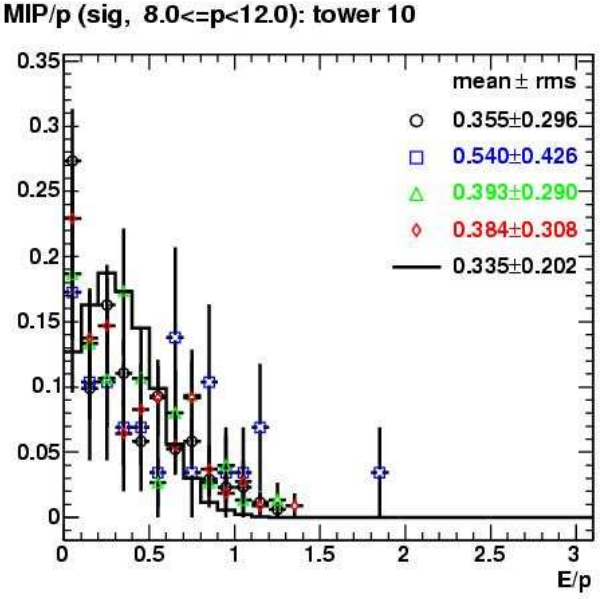


Tower 10 (8-12 GeV/c)

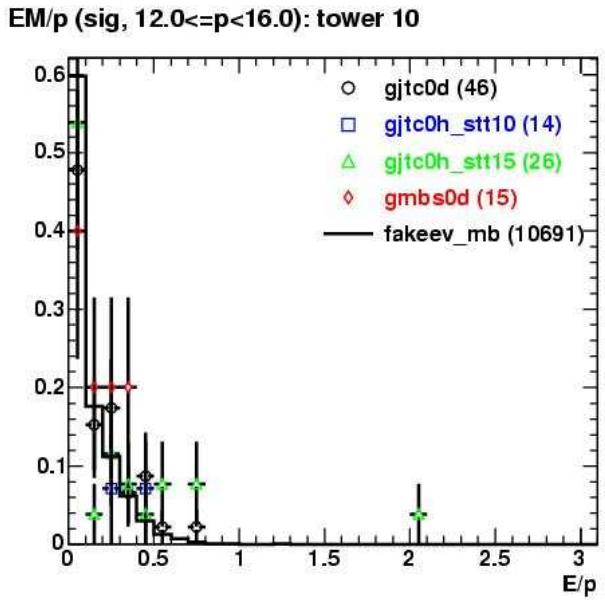


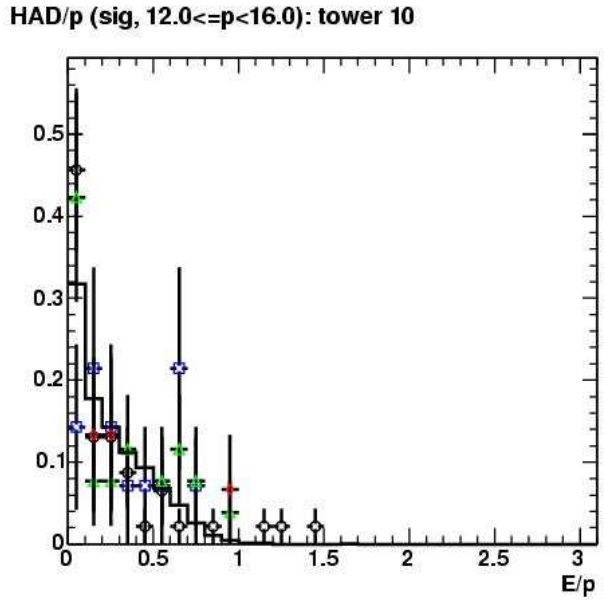


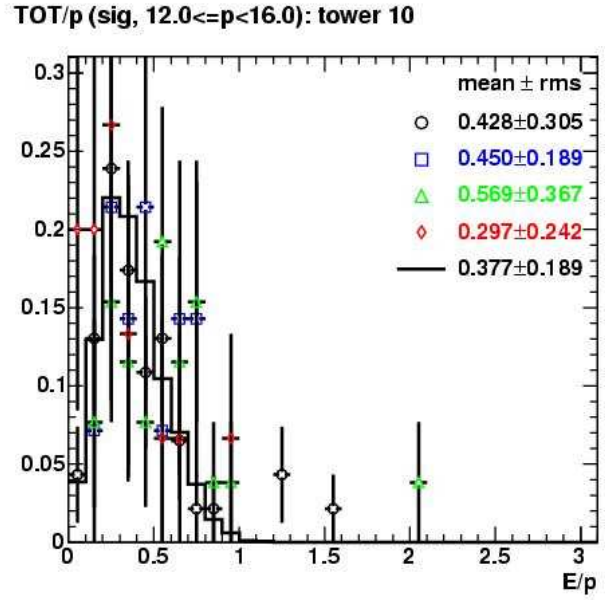


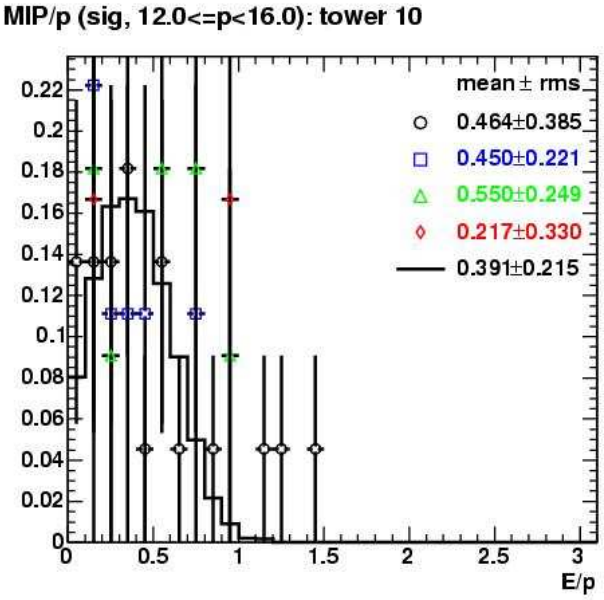


Tower 10 (12-16 GeV/c)

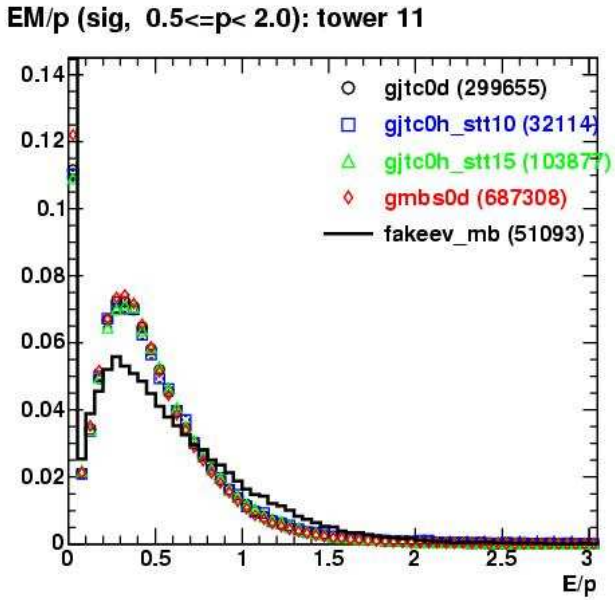


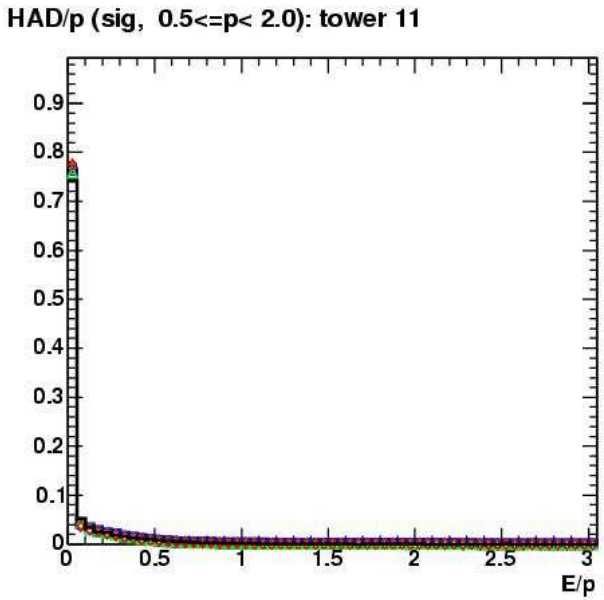


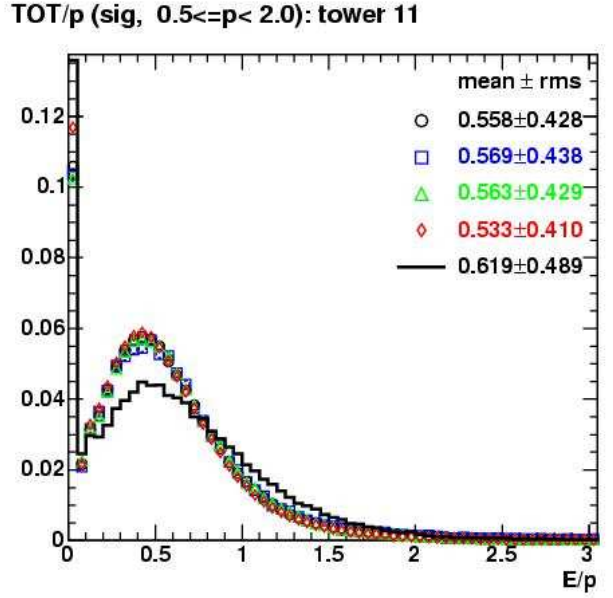


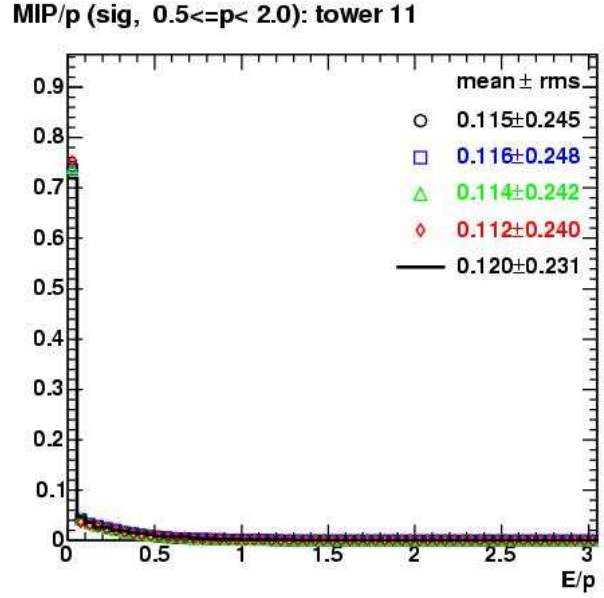


Tower 11 (0.5-2 GeV/c)

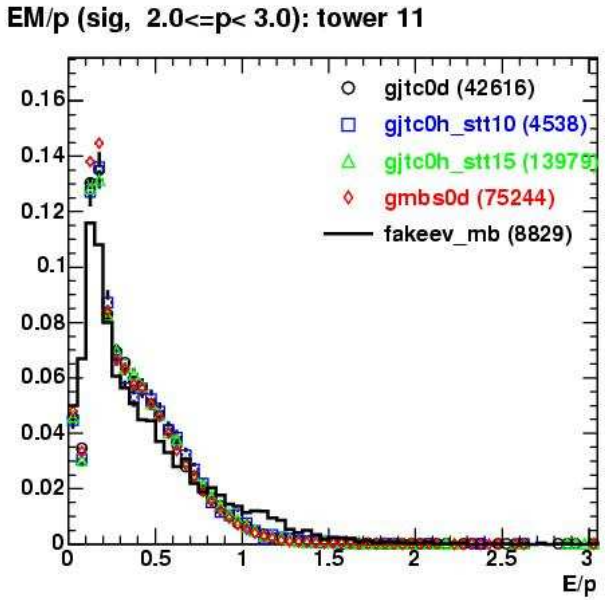


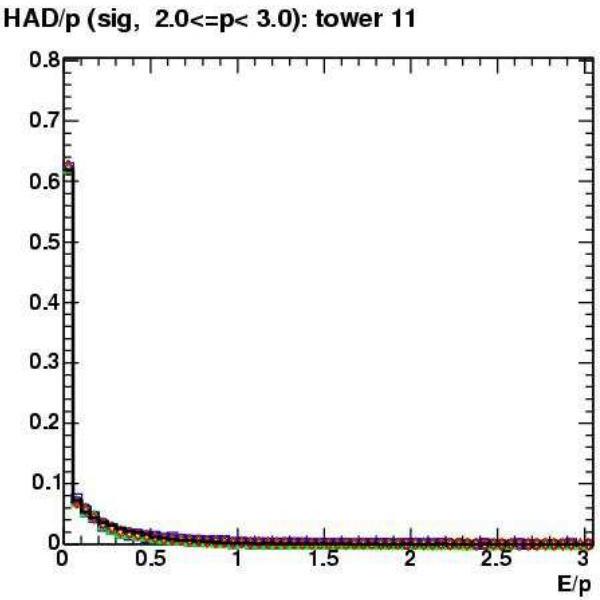


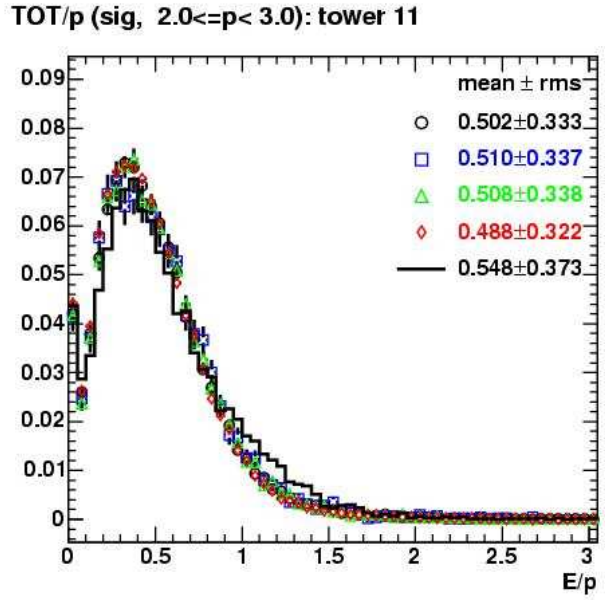


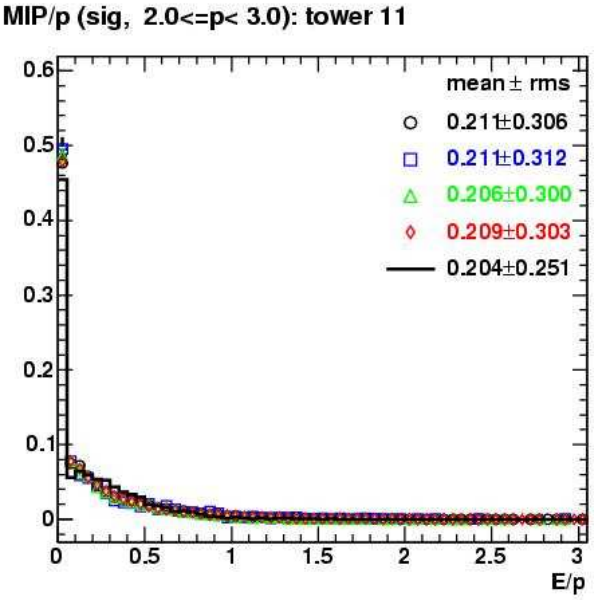


Tower 11 (2-3 GeV/c)

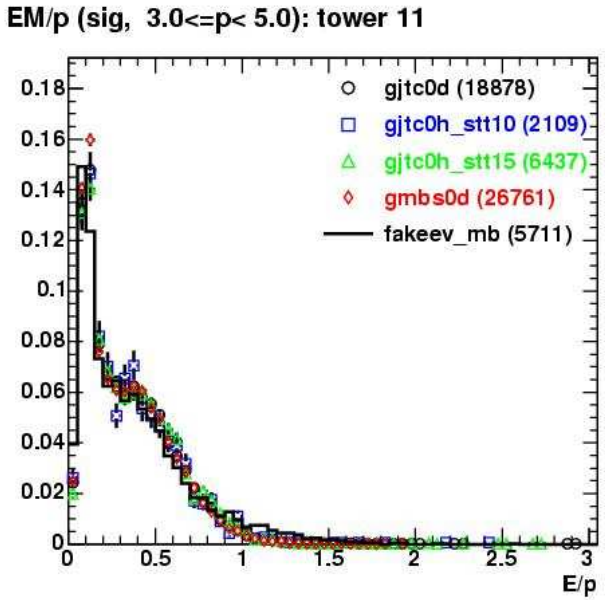


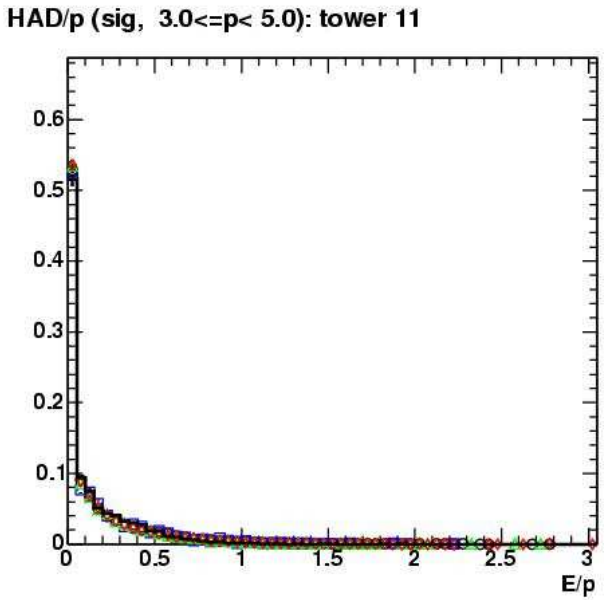


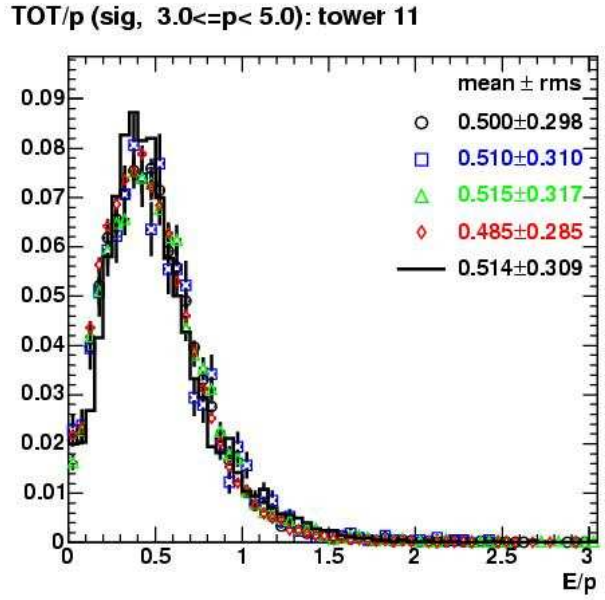


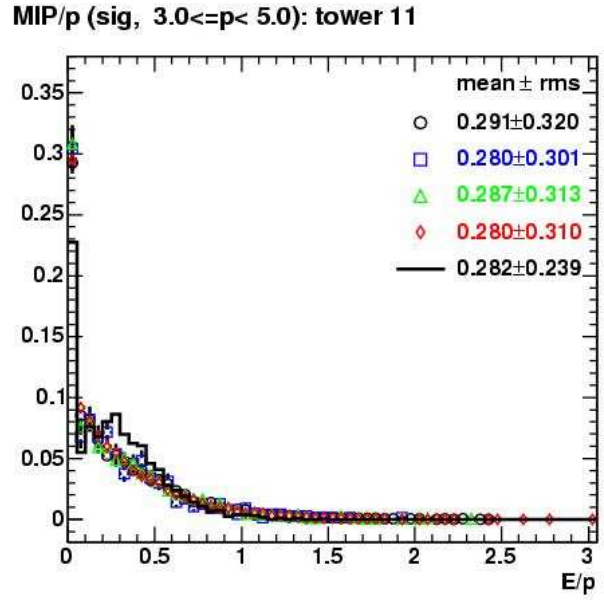


Tower 11 (3-5 GeV/c)

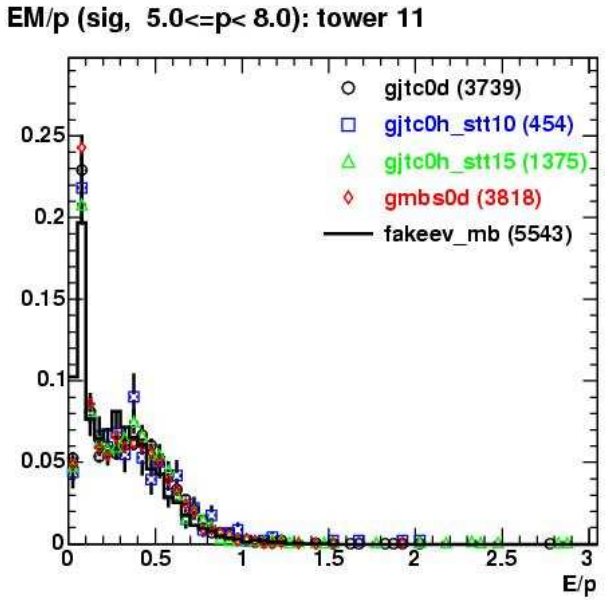


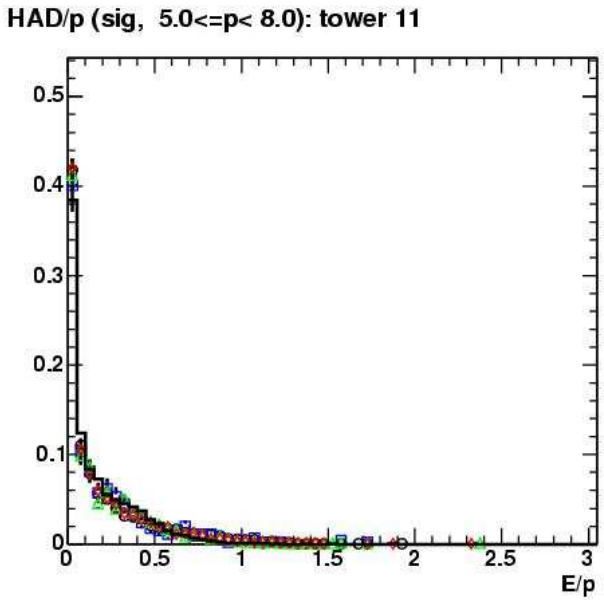


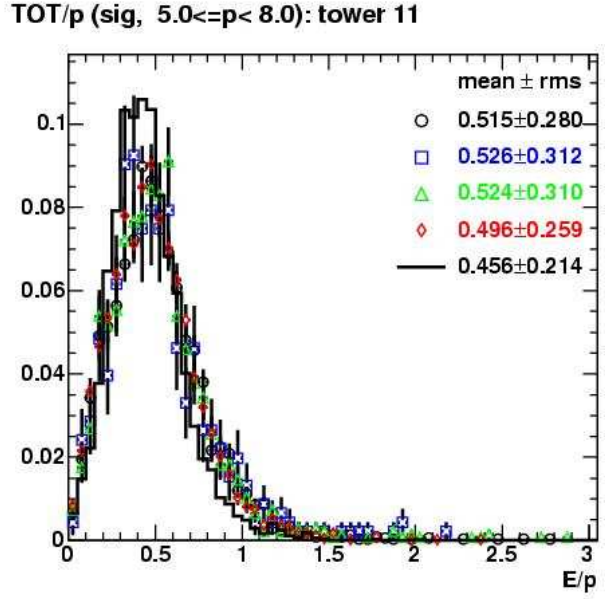


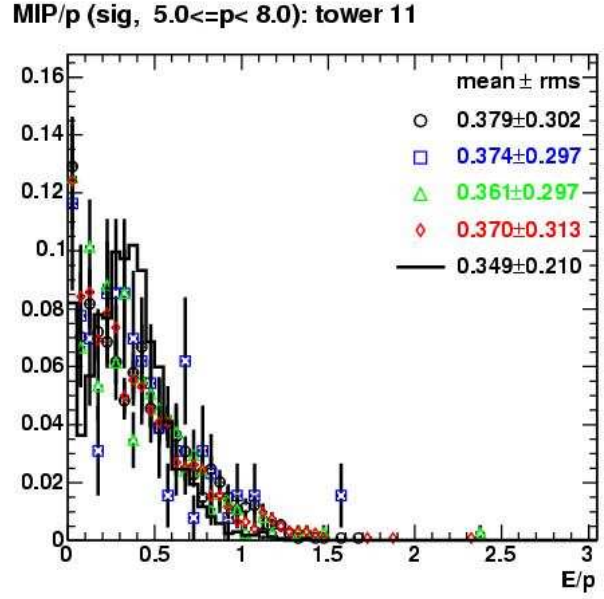


Tower 11 (5-8 GeV/c)

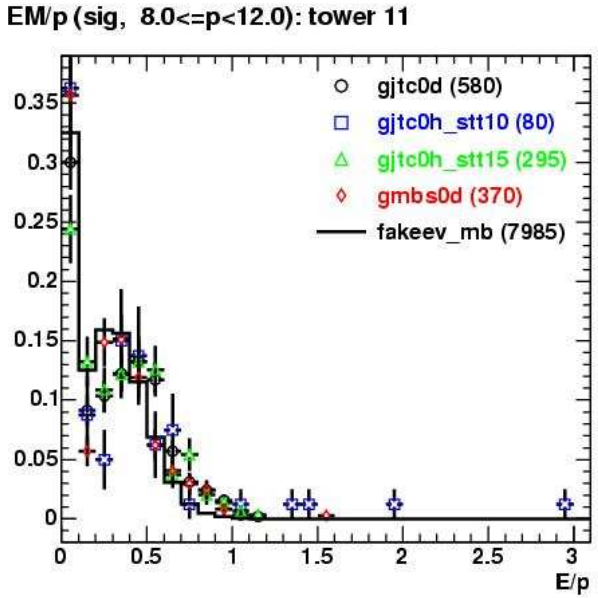


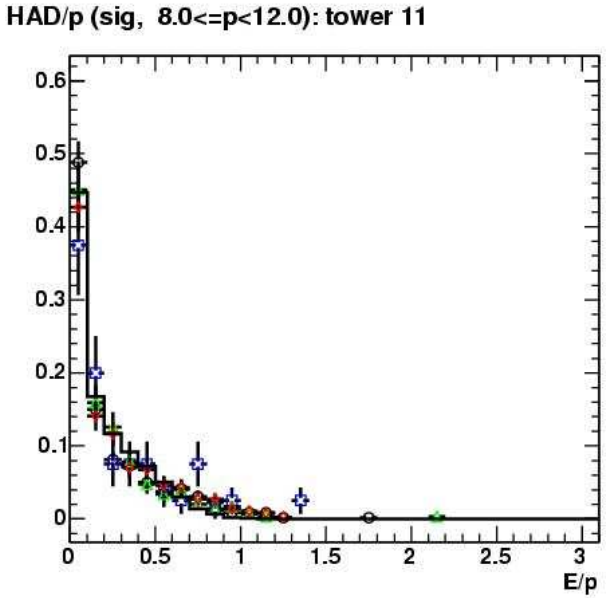


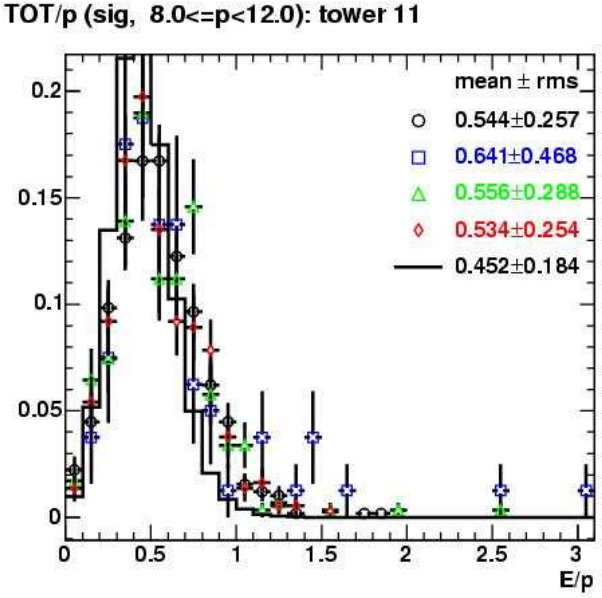


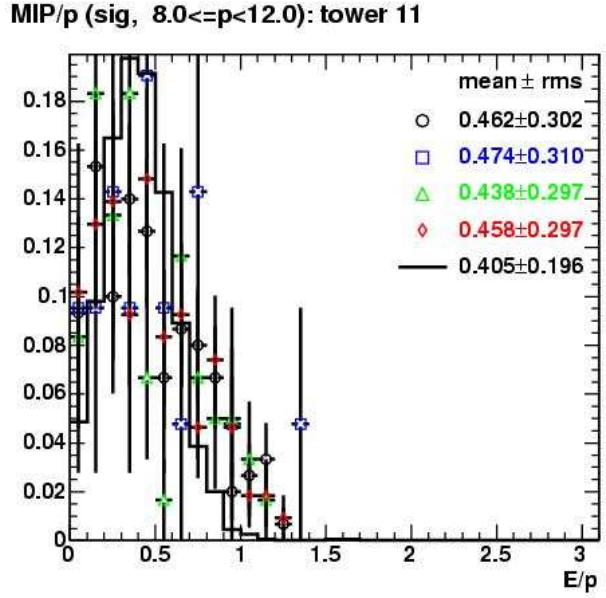


Tower 11 (8-12 GeV/c)

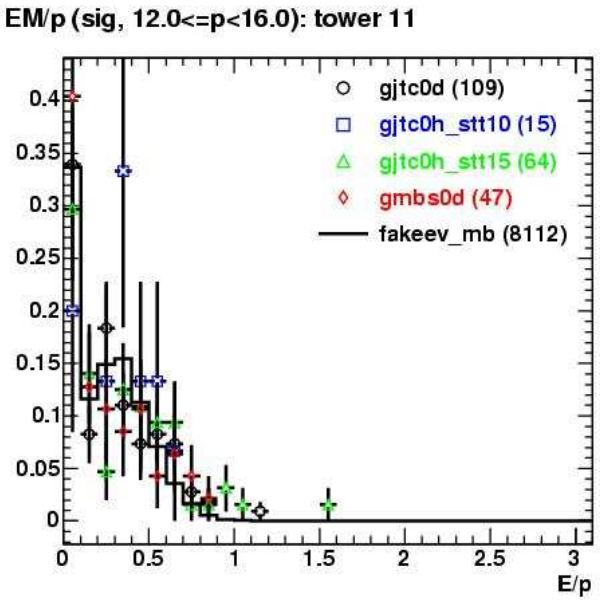


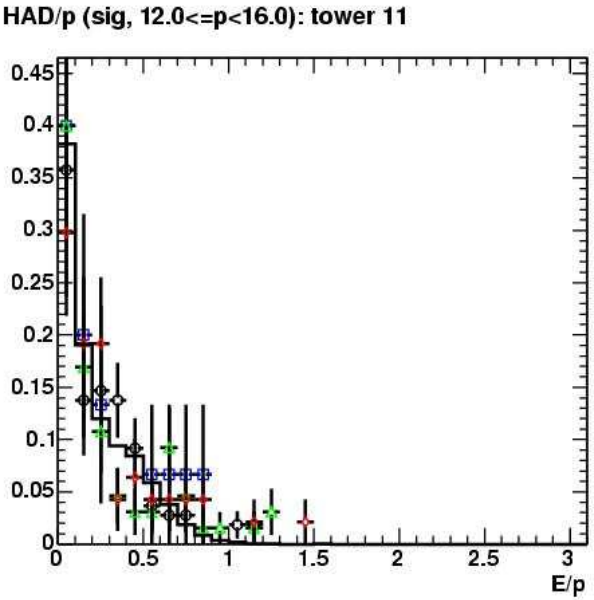


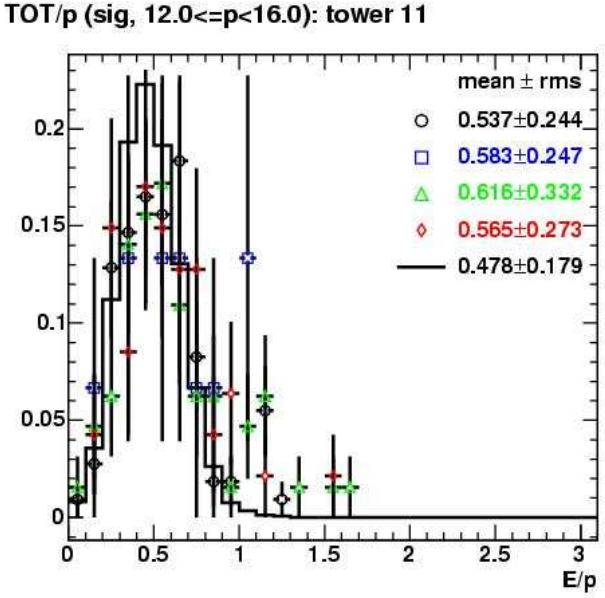


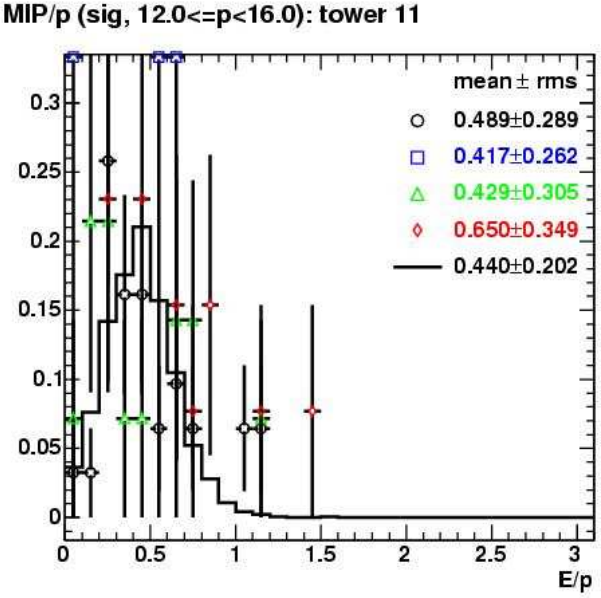


Tower 11 (12-16 GeV/c)

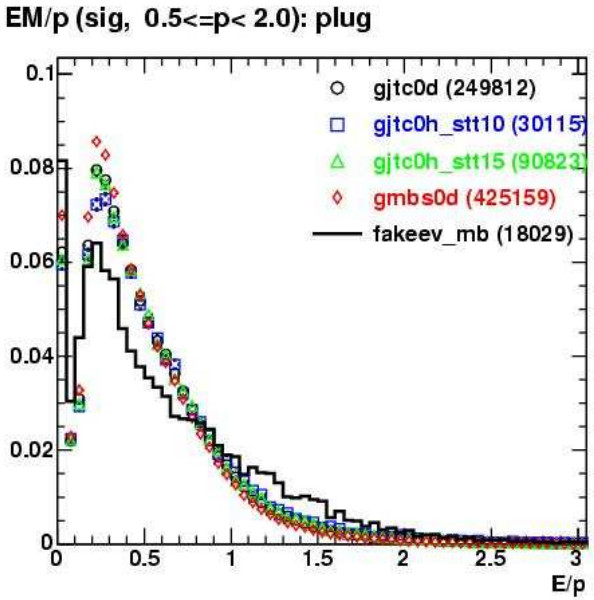


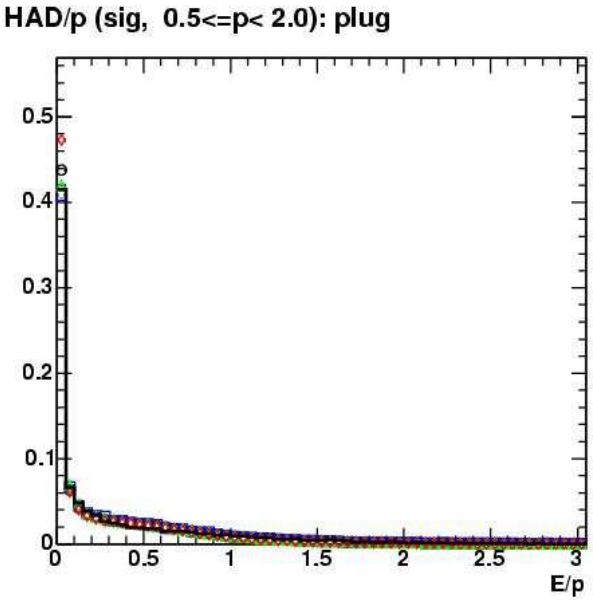


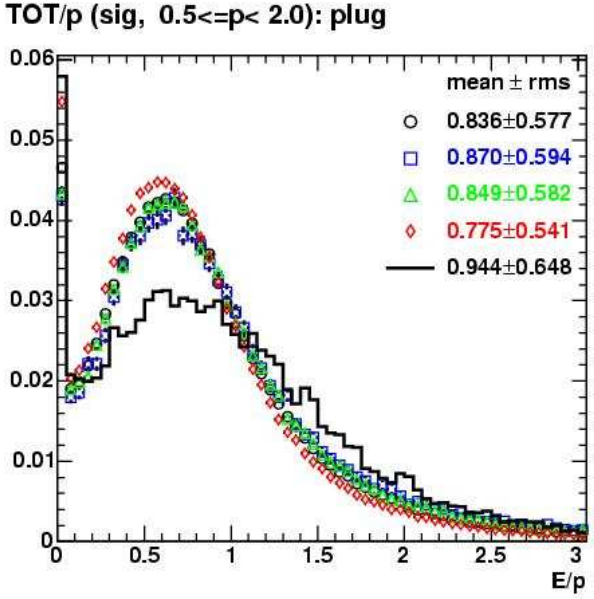


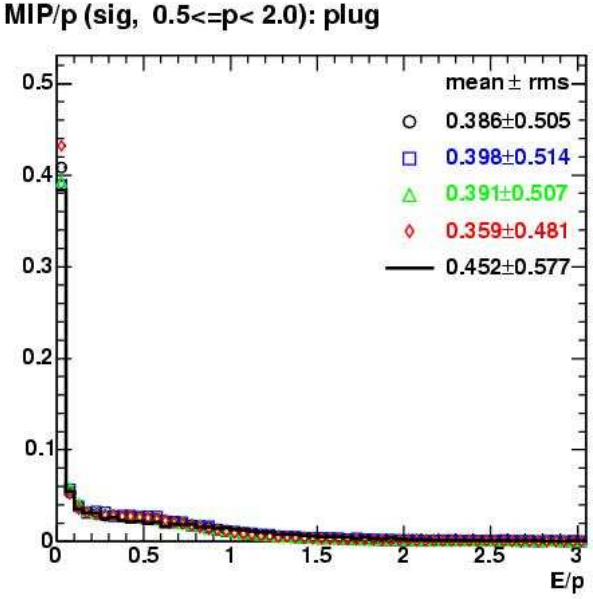


Plug (0.5-2 GeV/c)

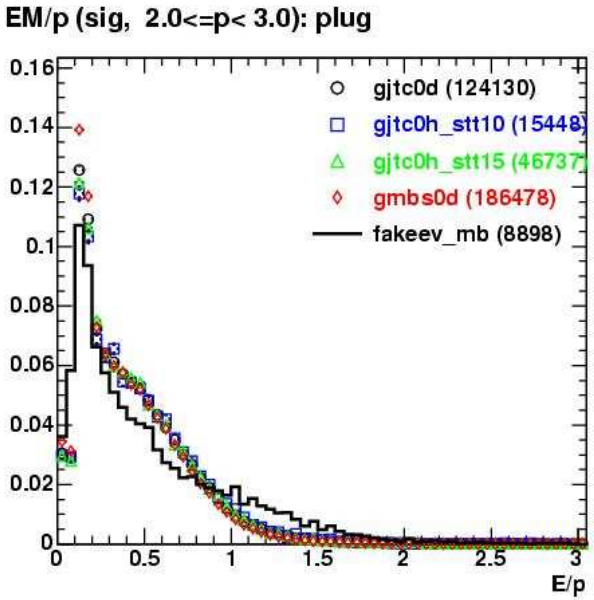


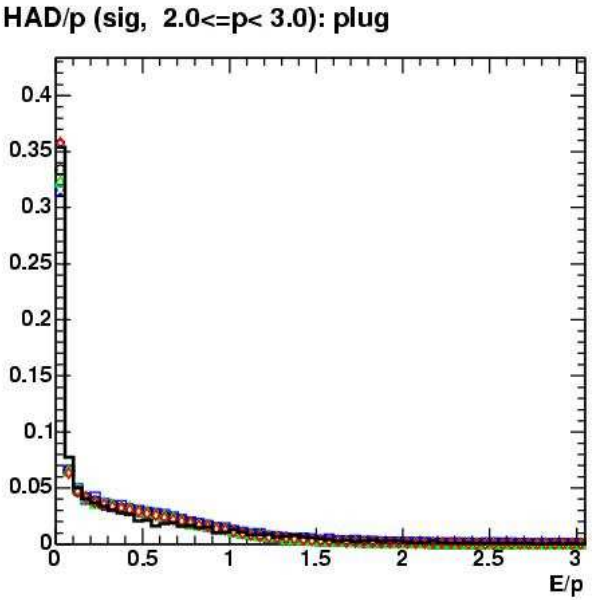


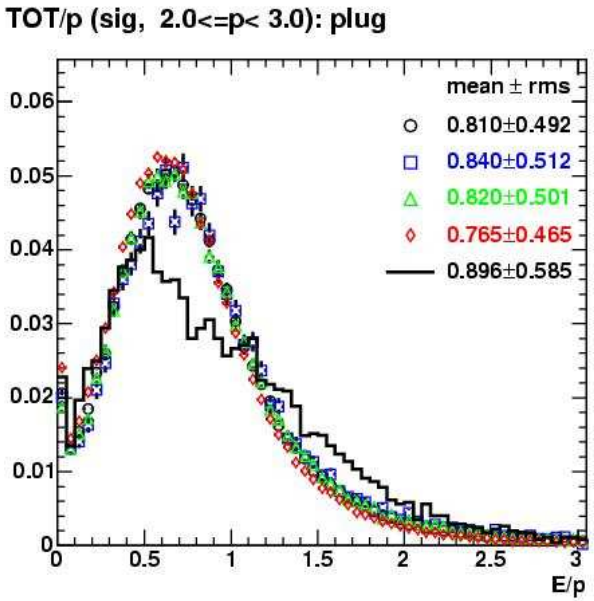


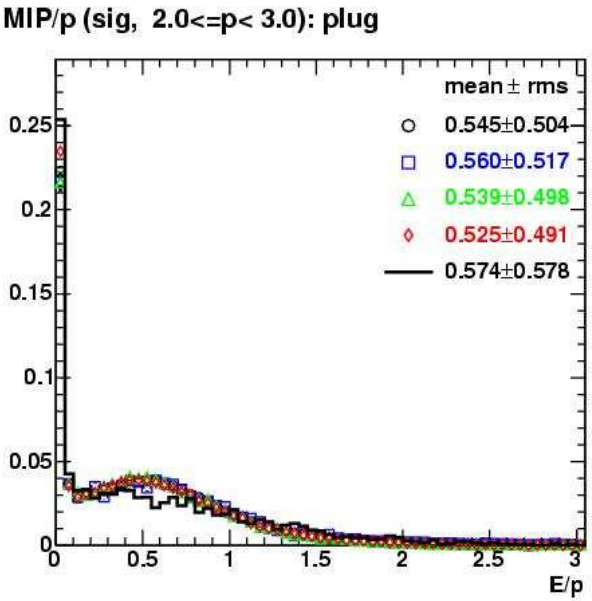


Plug (2-3 GeV/c)

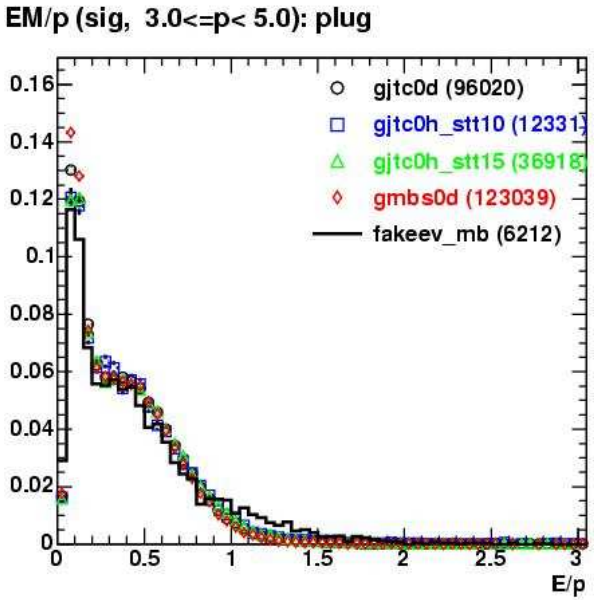

EM/p (sig, 2.0<=p< 3.0): plug
gjtc0d (124130)
gjtc0h_stt10 (15448)
gjtc0h_stt15 (46737)
gmbs0d (186478)
fakeev_mb (8898)
E/p

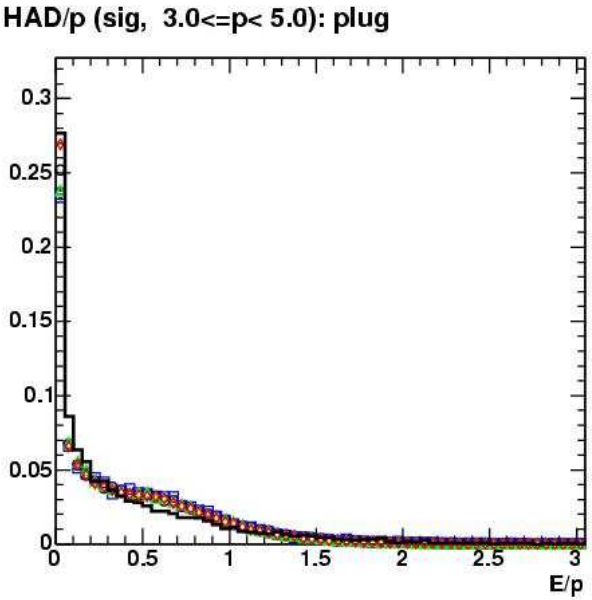

HAD/p (sig, 2.0<=p< 3.0): plug
E/p

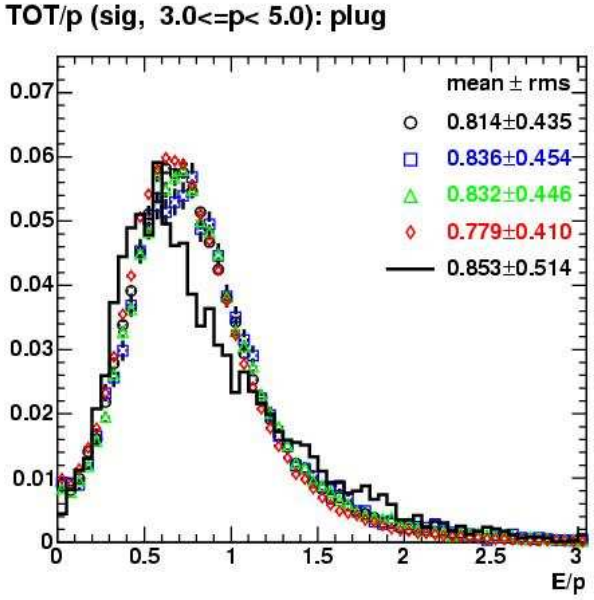

TOT/p (sig, 2.0<=p< 3.0): plug
mean ± rms
0.810±0.492
0.840±0.512
0.820±0.501
0.765±0.465
0.896±0.585
E/p

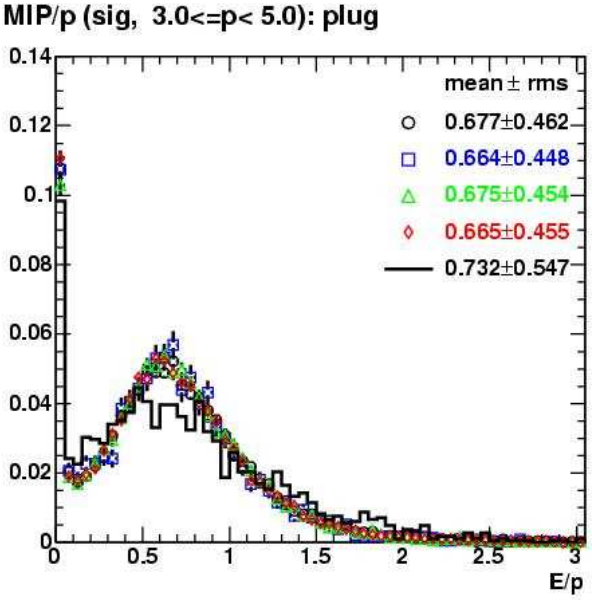

MIP/p (sig, 2.0<=p< 3.0): plug
mean ± rms
0.545±0.504
0.560±0.517
0.539±0.498
0.525±0.491
0.574±0.578
E/p

Plug (3-5 GeV/c)

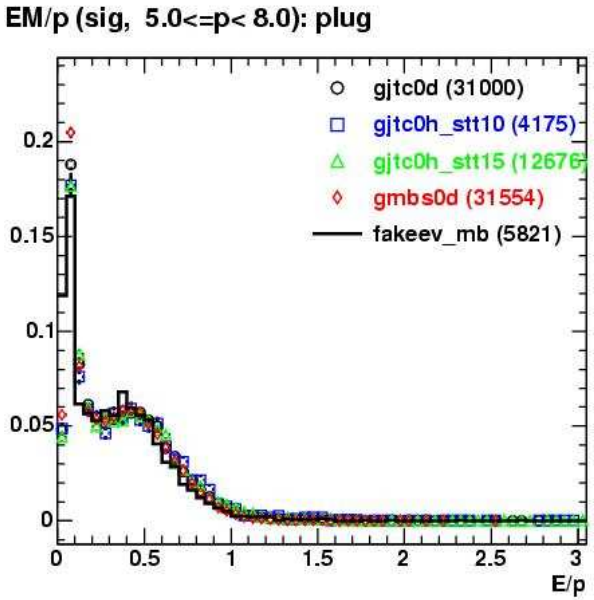

EM/p (sig, 3.0<=p< 5.0): plug
gjtc0d (96020)
gjtc0h_stt10 (12331)
gjtc0h_stt15 (36918)
gmbs0d (123039)
fakeev_mb (6212)
E/p

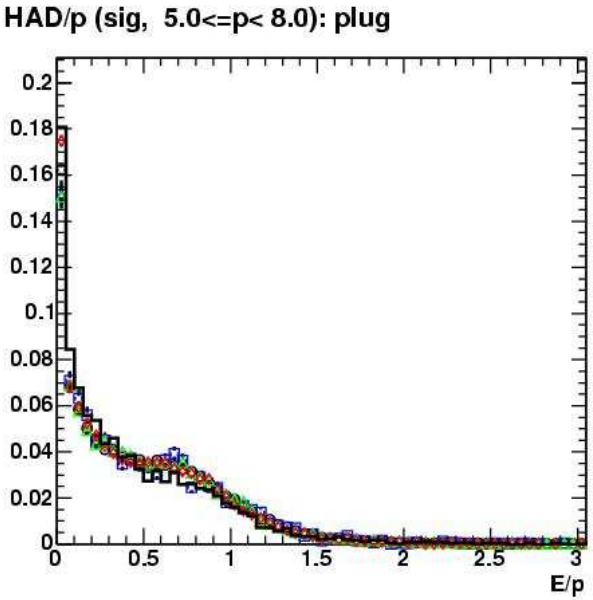

HAD/p (sig, 3.0<=p< 5.0): plug
E/p

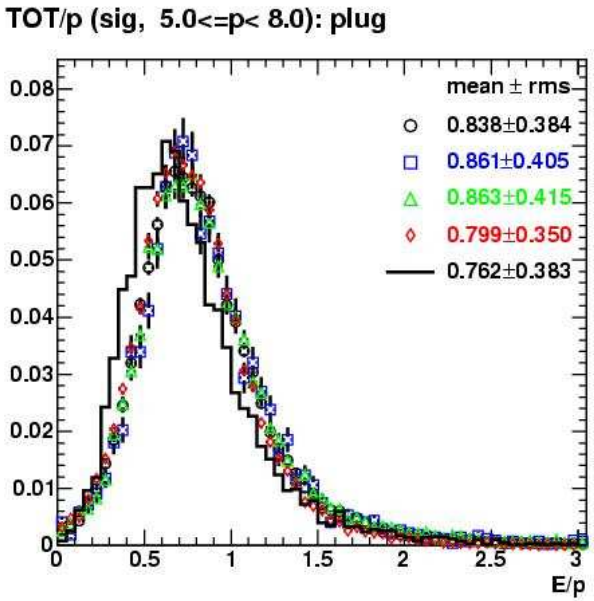

TOT/p (sig, 3.0<=p< 5.0): plug
mean ± rms
0.814±0.435
0.836±0.454
0.832±0.446
0.779±0.410
0.853±0.514
E/p

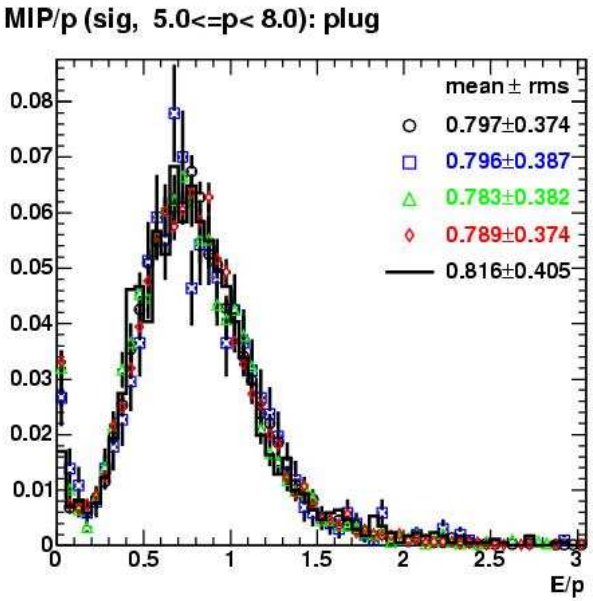

MIP/p (sig, 3.0<=p< 5.0): plug
mean ± rms
0.677±0.462
0.664±0.448
0.675±0.454
0.665±0.455
0.732±0.547
E/p

Plug (5-8 GeV/c)

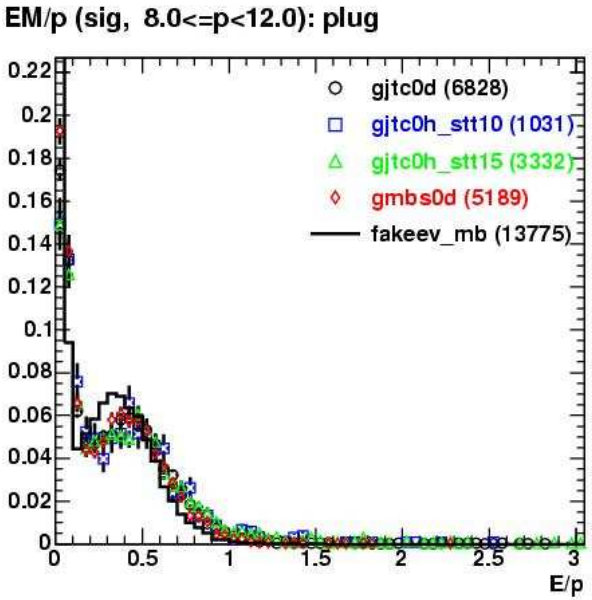

EM/p (sig, 5.0<=p< 8.0): plug
gjtc0d (31000)
gjtc0h_stt10 (4175)
gjtc0h_stt15 (12676)
gmbs0d (31554)
fakeev_mb (5821)
E/p

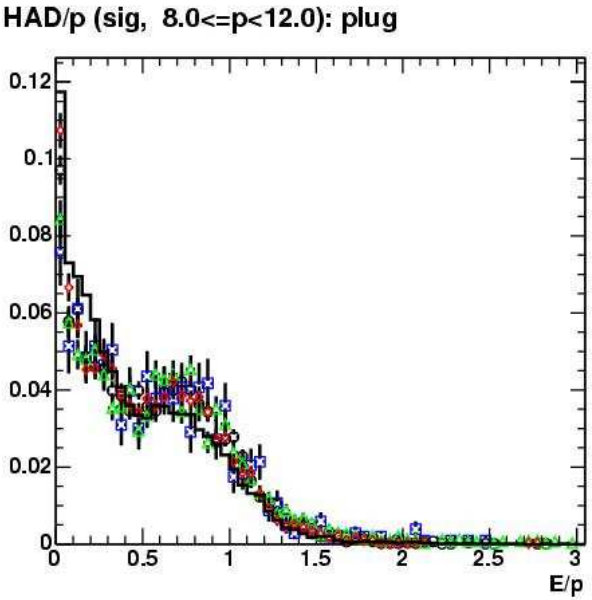

HAD/p (sig, 5.0<=p< 8.0): plug
E/p

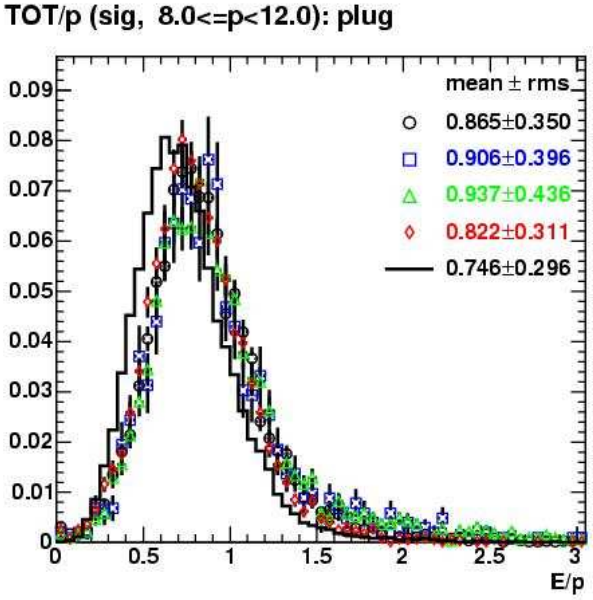

TOT/p (sig, 5.0<=p< 8.0): plug
mean ± rms
0.838±0.384
0.861±0.405
0.863±0.415
0.799±0.350
0.762±0.383
E/p

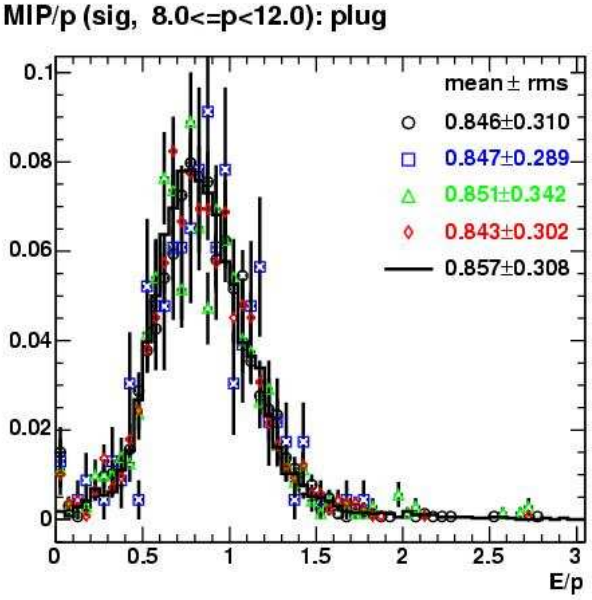

MIP/p (sig, 5.0<=p< 8.0): plug
mean ± rms
0.797±0.374
0.796±0.387
0.783±0.382
0.789±0.374
0.816±0.405
E/p

Plug (8-12 GeV/c)

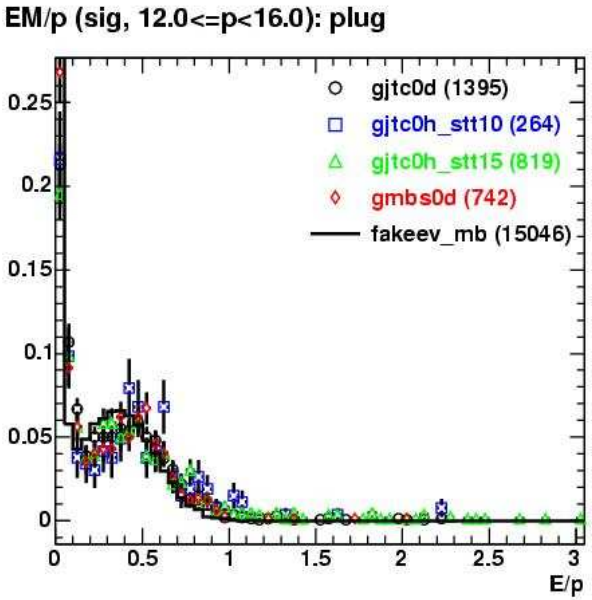


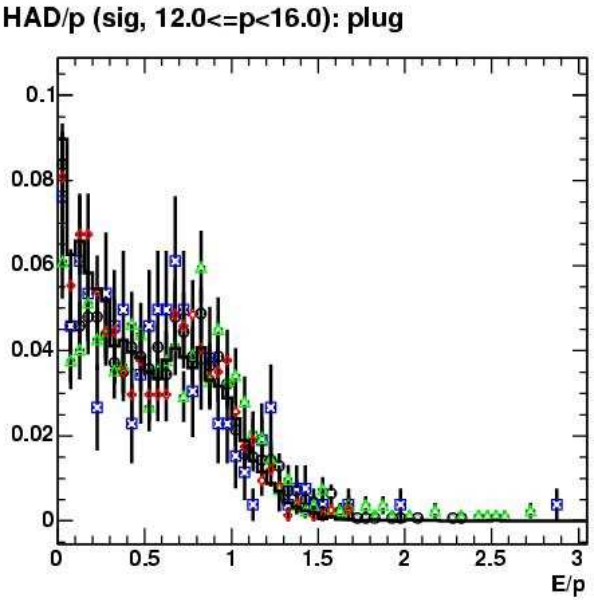


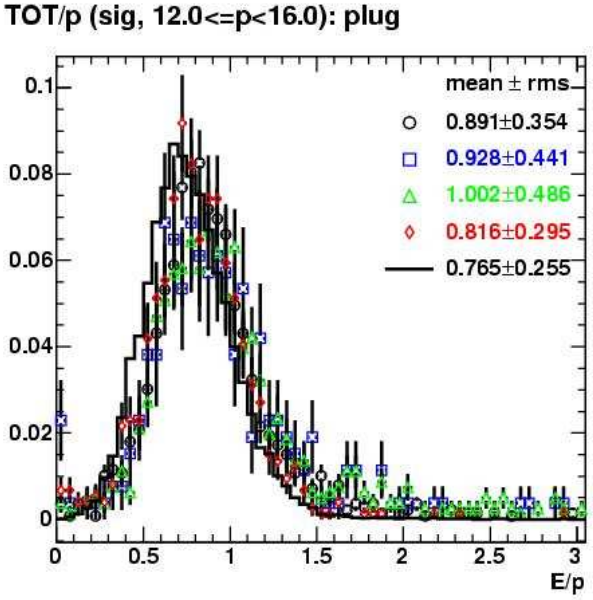


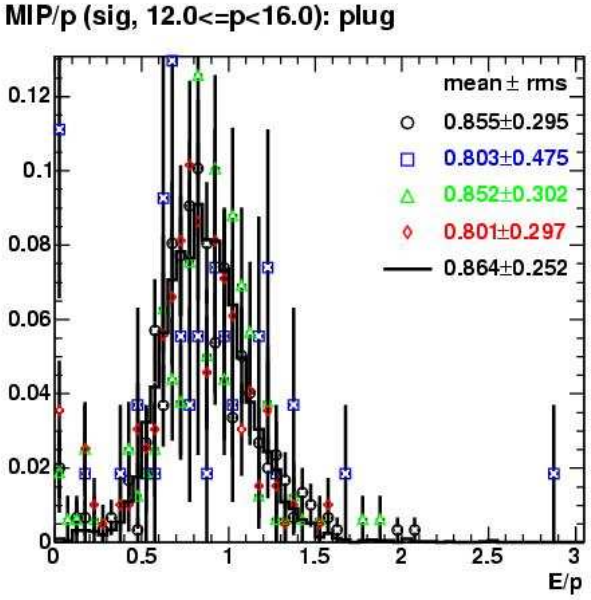


Plug (12-16 GeV/c)









Plug (16-24 GeV/c)